

Pacific *Lithophaga* (Bivalvia, Mytilidae) from recent French expeditions with the description of two new species

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Abstract

Pacific specimens of *Lithophaga* and its subgenus *Leiosolenus*, collected during recent French expeditions to New Caledonia, Vanuatu, the Philippines and French Polynesia, were determined and described, including two new species, *Lithophaga (Leiosolenus) paraplumula* n. sp. and *Lithophaga (Leiosolenus) subattenuata* n. sp. From the twenty species, three belong to *Lithophaga* s.s. and seventeen to the subgenus *Leiosolenus*. In order to help identification of the two new species and some others, selected specimens are figured in left lateral, right lateral and dorsal view. A taxonomic key is provided for determination.

Key words: Boring bivalves, *Leiosolenus*, *Lithophaga*, taxonomy, new species, Pacific.

Riassunto

[Specie pacifiche di *Lithophaga* (Bivalvia, Mytilidae) da recenti spedizioni francesi, con la descrizione di due nuove specie]. Il presente lavoro presenta lo studio di esemplari *Lithophaga* e del suo sottogenere *Leiosolenus*, raccolti in Nuova Caledonia, Vanuatu, Filippine e nella Polinesia Francese, in occasione di spedizioni francesi. Tutti gli esemplari vengono identificati a livello specifico, e descritti. Vengono introdotte due nuove specie: *Lithophaga (Leiosolenus) paraplumula* n. sp. e *Lithophaga (Leiosolenus) subattenuata* n. sp. Su venti specie esaminate, tre appartengono a *Lithophaga* s.s. e diciassette al sottogenere *Leiosolenus*. Al fine di favorire l'identificazione delle due nuove specie e di altre, vengono fornite le illustrazione di alcuni esemplari in vista laterale sinistra, laterale destra e dorsale. Inoltre, viene proposta una chiave di identificazione.

Parole chiave: Bivalvi perforatori, *Leiosolenus*, *Lithophaga*, sistematica, nuove specie, Pacifico.

Acronyms and abbreviations

AM - Australian Museum, IPUW - Institut für Paläontologie der Universität Wien, MNHN - Muséum national d'Histoire naturelle de Paris, MHNHS - Museo Nacional de Historia Natural Santiago, NHMUK - Natural History Museum United Kingdom.

BAI - Balicasag Island, BBC - Bohol Beach Club, BOI - Bohol Island, BS - Secteur de Belep, GB - Gaatcha Bay, KS - Secteur de Koumac, lv - left valve, NC - New Caledonia, NS - Secteur de Nouméa, PB - Palikulo Bay, PH - Philippines, PI - Panglao Island, PP - Palikulo Peninsula, rv - right valve, SB - Santal Bay, TS - Secteur de Touho, VA - Vanuatu, vs - versus, s.s. - sensu stricto.

Introduction

Since his thesis on the Mediterranean species *Lithophaga lithophaga* (Linnaeus, 1758), K. Kleemann has studied related species of boring mytilid bivalves in the field and laboratory at the Great Barrier Reef of Australia, the Caribbean, the Eastern Pacific and the northern Red Sea (Kleemann 1977, 1980a, 1984, 1986, 1990a, 1995, 2004, 2008). Additional taxonomic studies at several museums, particularly in 1976 and 1977 at the NHMUK, London, and in 1982 at the Smithsonian Institution, Washington, D.C., consolidated the state of knowledge on

the Lithophaginae. The present research was initiated and encouraged by Philippe Bouchet and involved working on the respective parts in the collections at the MNHN in Paris.

Material and methods

The present material was mainly collected in New Caledonia during the last two decades of the previous century (Lagon cruises 1982-1989, Montrouzier 1993, Lifou 2000), and more recently from French Polynesia, Rapa 2002, the Philippines, Panglao 2004, and Vanuatu, Santo 2006. The collections result from different localities along the biodiversity gradient from the Coral Triangle to the far east Polynesia. Generally, data on the localities are restricted to acronym of the expedition, station number, depth (range) and coordinates. Further information is rarely available or restricted to reef site(s) and/or substrate type(s), e.g., "sand with coral rubble". Most of the species are from dead coral, a few are coral associates. Nonetheless, apart from three exceptions, no coral pieces were preserved together with the bivalves. Length-height-width measurements of specimens are given to the nearest 0.1 mm where possible. The species are treated in alphabetical order.

The material is stored at the MNHN and was investigated under a dissecting microscope. Determinations on

the species level are based on morphological features of the shell (valves) and, in the case of the subgenus *Leiosolenus*, also on the type of the posterior incrustation pattern (Kleemann 1977, 1980a, 1980b, 1982, 1984, 1986, 1990a, 1990b, 1994, 2008, 2009, Kleemann & Hoeksema 2002). In the sense of Kleemann, *Leiosolenus* Carpenter, 1856, type species *Lithophaga spatiosa* (Carpenter, 1856), includes also the subgenera *Myoforceps* Fischer, 1886, type species *L. aristata* (Dillwyn, 1817), *Diberus* Dall, 1898, type species *L. plumula* (Hanley, 1843), *Labis* Dall 1918, type species *L. attenuata* (Deshayes, 1836), *Myapalmula* Iredale, 1939, type species *L. dichroa* Iredale, 1939, [= *nasuta* (Philippi, 1846)], *Doliolabis* Iredale, 1939, type species *L. laevigata instigans* Iredale, 1939, [= *lanleyana* (Reeve, 1857)], *Exodiberus* Iredale, 1939, type species *L. calcifer* Iredale, 1939, [= *malaccana* (Reeve, 1857)], *Salebrolabis* Iredale, 1939, type species *L. divaricalx* Iredale, 1939, and *Stumpiella* Soot-Ryen, 1955, type species *L. calyculata* (Carpenter, 1856) [? *mucronata* (Philippi, 1846)].

Images were taken with digital camera using "Combine Z" by P. Maestrati.

A key to the *Lithophaga* s. s. and *L. (Leiosolenus)* species found in the above regions is compiled and presented as appendix.

Systematics

Class Bivalvia Linnaeus, 1758

Order Mytiloida J. Féussac, 1822

Superfamily Mytiloidea Rafinesque, 1815

Family Mytilidae Rafinesque, 1815

Subfamily Lithophaginae H. Adams & A. Adams, 1857

Tribe Lithophagini H. Adams & A. Adams, 1857

Lithophaga Röding, 1798. Type species, *Lithophaga mytiloides* Röding, 1798 (= *Mytilus lithophagus* Linnaeus, 1758).

Cylindrical in general shape, anterior end hemispherical, posterior wedge-shaped, lacking any self-deposited calcareous incrustation (no lined boreholes), antero-ventrally fine anti-marginal periostracal striae otherwise smooth, additional diagonally criss-crossing threads dorso-posteriorly in *L. corrugata* (Philippi, 1846) [syn. *L. antillarum* (d'Orbigny, 1853)].

Lithophaga (Lithophaga) corrugata (Philippi, 1846)

Modiola corrugata Philippi, 1846: p. 1/147, pl. 1, fig. 1. Kleemann, 1983: p. 7.

Lithophaga corrugata Philippi - Dunker, 1880-83: pp. 17, 18 (1883), pl. 6 (1882), figs 13, 14.

Lithodomus antillarum d'Orbigny in Sagra, 1853: p. 332, atlas pl. 28, figs 12, 13. Non Philippi, 1847a: p. 116. Kleemann 1980b: p. 239.

Lithophagus caperatus Philippi, 1849: pp. 25, 26. Kleemann, 1980b: p. 239.

Lithodomus saucatensis Mayer, 1858: p. 78. Kleemann, 1980b: p. 240.

Lithodomus lyellanus Mayer in Hartung, 1864: pp. 218, 219, pl. 4, figs 23a, b (non c, d). Kleemann, 1980b: p. 240.

Lithophaga straminea Dunker, 1880-83: pl. 2, figs 1, 2 (1880), pp. 6, 7 (30, 32). Non Reeve, 1857: sp. 11, pl. 2, fig. 11. Kleemann, 1980b: p. 240.

Lithodomus ornatissimus Mayer-Eymar, 1887: pp. 24, 25, pl. 3, fig. 2. Kleemann, 1980b: p. 240.

Lithophagus tirolensis Tausch, 1890: p. 18, pl. 8, figs 10a-e. Kleemann, 1980b: p. 240, figs 13-15.

Lithodomus isilensis Parona, 1893: pp. 176, 177, pl. 3, figs 12, 13. Kleemann, 1980b: p. 240.

Lithophagus taurorugosus Sacco in Bellardi, 1898: p. 46, pl. 12, figs 15, 16.

Lithophagus papilliferus Joksimowitsch, 1910: p. 65, pl. 2, fig. 3.

Lithodomus styriacus Teppner, 1914: p. 112, pl. fig. 2. Kleemann, 1980b: p. 240.

Lithodomus mitzopoulosi Charalambakis, 1952: pp. 105, 106, pl. 8, fig. 2. Kleemann, 1980b: p. 240.

Lithophaga corrugata (Philippi) - Huber, 2010: p. 119, left figure in 3rd row.

Lithophaga zitteliana Dunker - Poppe in Kleemann, 2010: p. 502, pl. 942, fig. 8.

Types

The type of *Modiola corrugata*, 85.6-26.3-24.2 mm (Kleemann 1983: p. 7), is probably at MHNHS, Chile. Type locality, Westindien (Philippi 1847b: 7/p. 21). Lectotype of *L. antillarum* d'Orbigny, NHMUK 1854.10.4.605/1, 86.1-23.2-18.7 mm (figured in Turner & Boss 1962: pl. 75, fig. 1). Type locality, Martinique. For other types see Kleemann (1980b, 1983).

Material examined

Coral 2, 1988, Stn CP124, 19° 29' S 158° 20' E, 53-56 m, 29Jul: 32.4-9.2-? mm. As before, Stn DW146, 19° 37' S 158° 16' E, 44 m, 30Jul: 98.2-25.1-20.3 mm (anterior vs posterior ~55:45 mm, age ~>25 a). New Caledonia, Lifou 2000, Stn 1419, 20° 55.6' S 167° 04.5' E, 5 m, limon sur dalle, algues photophiles, 10Nov: ~120-34.0~25.5, 44.2-11.5-8.8, ~40, 36.6-8.6-6.8, 36.3-9.2-7.1, 25.5-6.8-5.1 mm. Stn 1424, 20° 54.9' S 167° 03.0' E, 4 m, vers le Cap Mandé, sable fin et algues photophiles sur dalle, 15Nov: 57.7-16.5-14.1 mm. Stn 1455, 20° 56.8' S 167° 02.7' E, 15-20 m, entre le Cap Wekutr et le Cap Wajez, tombant, 25Nov: 38.7-9.9-8.2 mm. Stn 1459, 20° 47.0' S, 167° 03.0' E, face à la plage de Ngoni, 55-60 m, 5/13Nov: 47.8-13.2-9.6 mm. Stn 1465, 20° 47.7' S 167° 07.0' E, de part et d'autre de la Pointe d'Easo, dragages, blocs et coraux, 35-45 m, 16Nov: ? *corrugata*, rv 28.9-8.2-(3.2 x2) mm.

Diagnosis

Lithophaga s.s., posterior shell surface with additional criss-cross striation.

Description

Shell subcylindrical, anterior hemispherical, less high than wedge-shaped, minimally attenuated posterior,

whose ending is semicircular. Surface ornamentation as in *Lithophaga* s.s. plus additional striae dorso-latero-posteriorly, resulting in the species-specific rhombo-reticulate pattern (Kleemann 1980b: pl. 1, figs 14, 15). In large specimens, probably annual growth-breaks are marked by distinct steps in shell length prolongation (Kleemann 1980b: pl. 1, figs 1-8). Umbos sub-terminal, ligament straight, dorsal angle usually inconspicuous, periostracum yellow, free from self-deposited incrustations.

Remarks

Largest of all species, reaching 145 mm in length at Heron Island, Great Barrier Reef of Australia. Occurring also in the Caribbean, boring dead parts of coral. Length of the largest specimen in MNHN measures ~120 mm. Depth range in the present material 5-55 m. Fossils are reported mainly from the Miocene, but the species (as *tirolensis*) appears unchanged in outer shell morphology since the Middle Liassic (Kleemann, 1980b, 1986, 1990a).

Lithophaga (Lithophaga) straminea (Reeve, 1857)

Lithodomus stramineus (Dunker MS) Reeve, 1857: sp. 11, pl. 2, fig. 11.

Non *Lithophaga straminea* Dunker 1880-83: pp. 6, 7 (1882), pl. 2, figs 1, 2 (1880) = *L. corrugata* (Philippi, 1846).

Lithophaga zitteliana Dunker, 1882: pp. 226, 227, pl. 14, figs 1-3, 8, 9. Dunker, 1880-83: p. 18 (1883), pl. 6 (1882), figs 17, 18. Nielsen, 1986: p. 5, fig. 2B. Non Poppe in Kleemann, 2010: p. 502, pl. 942, fig. 8 (= *L. corrugata*).

Types

Syntypes, NHMUK 197590 1-3, 96.5-27.0-23.4 mm, marked 14, ? the figured specimen, 85.9-23.8-20.1 mm, and 78.4-22.9-19.4 mm. Type locality, Philippines (see remarks). The type of *zitteliana*, probably at NHMUK, ~70 mm, was not located. Type locality, Japan Sea.

Material examined

New Caledonia, Expédition Montrouzier, TS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut-Fond de la Tié, tombants, sable sur dalle, 5-25 m: 9.2-2.9-2.4, lv 5.6, 3.7 mm. Lifou 2000, SB, Stn 1464, 20° 54.5' S 167° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 19.5-5.5-4.5 mm. GB, Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sable et débris coralliens, 20-30 m, 10Nov: >> 21~7-? mm.

Diagnosis

Lithophaga s.s. with yellow periostracum.

Description

Shell subcylindrical, anterior end hemispherical, wider posterior wedge-shaped, lacking criss-crossed striae.

Remarks

Generally incorrectly using the terms anterior and posterior, Reeve (1857: sp. 11) mentioned: 'There is little to distinguish this species from *L. lithophagus* except its paler tone of colour, which is a character insufficient from its variableness.' Therefore, and because fig. 11 probably depicts the largest of the three syntypes although from the Philippines and not West Indies as (erroneously) stated, Reeve's *straminea* was considered a variety of the Mediterranean *L. lithophaga* (Linnaeus, 1758) by Kleemann (1983: p. 23). Here, it is regarded as a distinct species in the *Lithophaga* s.s. complex. Dunker (1882: p. 6) considered his *straminea* to be likely a splendid variety of *corrugata*, stating he had insufficient material for comparison.

Lithophaga (Lithophaga) teres (Philippi, 1846)

Pholas niger Lister, 1685: pl. 427, fig. 268 (*uonien oblitum*).

Mytilus lithophagus (part) Linnaeus, 1758: p. 705 (Box Two); Chemnitz, 1785: pp. 147-151, pl. 28, fig. 729 (non 730).

Modiola lithophaga (part) Lamarck, 1819: pp. 115, 116. Kleemann, 1984: p. 210, fig. 20 left and centre.

Modiola teres Philippi, 1846: p. 2/148, pl. 1, fig. 3.

Modiola (Lithophagus) antillarum Philippi, 1847a: pp. 116, 117; 1847b: 6/p. 20, pl. 2, fig. 4.

Modiola (Lithophagus) caribaea Philippi, 1847a: pp. 116, 117; 1847b: 6/p. 20, pl. 2, fig. 5.

Modiola (Lithophagus) gracilis Philippi, 1847a: pp. 117, 118; 1847b: 5/p. 19, pl. 2, fig. 1. Kleemann, 1983: p. 10. Kleemann, 1984: fig. 23 (holotype).

Modiola (Lithophagus) malayana Philippi, 1847a: p. 117; 1847b: 7/p. 21, pl. 2, fig. 6.

Lithophaga creuulata Dunker, 1849: p. 180. Dunker 1880-83: p. 11, pl. 3, figs 7-9.

Lithodouus niger d'Orbigny in Sagra, 1853: pp. 331, 332, pl. 28, figs 10, 11.

Lithophaga ventrosa Dunker, 1880-83: 4 (1882), pl. 1, figs 3-4 (1880, unnamed). Kleemann, 1983: 25; Kleemann, 1984: p. 210.

Dactylus erythraeensis Jousseaume, 1888: pp. 218, 219. Kleemann, 1983: p. 9; Kleemann, 1984: p. 211.

Lithophaga teres annectans Iredale, 1939: p. 422, pl. 6, fig. 29. Wilson, 1979: fig. 16/1a-c (holotype). Kleemann, 1984: fig. 24 (holotype).

Lithophaga teres annectens Iredale -Allan, 1950: p. 294, pl. 38, fig. 2. *L. erythraeensis* Lamy (in error for *erythraeensis* Jousseaume) - Wilson 1979: p. 484, figs 16/2a-c, 3a-c.

Lithophaga (Lithophaga) nigra d'Orbigny - Kleemann, 1984: pp. 210-218.

Lithophaga teres Philippi - Oliver, 1992: p. 46, 54, 228, text-fig. 22, pl. 7, fig. 3ab. Huber, 2010: p. 119, middle figure in 3rd row. Kleemann, 2010: p. 500, pl. 941, figs 1ab, 2.

Types

Holotype of *M. teres* is probably lost, non MNHNS 50671 = young *L. attenuata* (Deshayes, 1836) (Kleemann 1984: p. 210, fig. 22). Type locality, Pacific. The type of *antillarum* Philippi, non MNHNS 50651 (Kleemann, 1980b: p. 241, pl. 1, figs 11, 12; 1984: p. 210), is probably lost. Type locality, St. Thomas (Caribbean). The types of *caribaea* and *malayana* Philippi, non MNHNS 50345 (Kleemann 1984: p. 210, fig. 23) are probably lost.

emann, 1980b: pl. 1, figs 4, 5; 1984: p. 210), could not be found and are probably hidden in the collections of the MNHN. Type locality, Antillae and China, respectively. MNHN 50338, holotype of *gracilis* Philippi, 105.2-27.4-22.8 mm (Kleemann, 1983: p. 10; 1984: p. 210, fig. 23). Type locality, China. The type of *crenulata* Dunker, 29-7-6.5 mm, from Porto Cabello, Venezuela (Dunker 1880-83: p. 11), is probably lost. *Lithodomus niger* d'Orbigny, NHMUK 1854.10.4.604, lectotype, 46.3-14.3-12.3 mm (Turner & Boss, 1962: p. 113, pl. 75, fig. 2), 3 paratypes, 41.7-13.1-11.3 mm (Turner & Boss 1962: pl. 75, fig. 3), 41.5-15.4-14.3 mm, and 50.6-16.7-(7.3x2) mm. Type locality, Guantánamo (Turner & Boss, 1962: p. 98). NHMUK 197736/1, holotype of *ventrosa*, 43.5-16.7-14.3 mm. Type locality, Lord Hood's Is. 12 syntypes of *erythraensis* are at MNHN (for measurements see Wilson 1979: p. 441). Type locality, Obock, Erythraea. AM C60406, holotype of *teres annectans*, 64.8-17.6-15.0 mm (Kleemann, 1984: fig. 24). Type locality, Low Isles.

Material examined

New Caledonia, Lagon 1984, Stn 99, 22° 33 S, 166° 35' E, Ile Ouen, Baie du Prony, 14 m, 21Aug: ~30, 30.5-10.1-9.4 mm (dead). Stn 121, Ile Ouen, Baie du Prony, 12 m, 22° 28 S, 166° 43' E, 23Aug: ~120~30~28 mm. Ile Ouen, Baie du Prony, Stn 160, 10 m, 22° 36 S, 166° 37' E, 24Aug: >72, >65, >65, >40 mm. As before: 29.1-10.0~9 mm. NS, Stn 283, 22° 27' S 166° 24' E, 13 m, 09Nov: 22.3-8.0? mm. Grand Récif Sud, Stn 294, 21 m, 22° 44' S 166° 42' E, 26Nov: 15.9 mm. Grand Récif Sud, Stn 341, 19 m, 22° 49' S 166° 46' E, 28Nov: 16.0 mm. Grand Récif Sud, Stn 308, 18 m, 22° 46' S 166° 43' E, 27Nov: 16.3 mm, 12.8 mm. Chalcal 1984, Mer de Corail, Plateau Chesterfield-Bellona, Stn D15, 19°23'30 S 158° 38'60 E, 65 m: lv 24.8-8.6-(3.4 x2) mm (predation hole ~1 mm, ~18 mm ventro-lateral from beak). As before, Stn D26, 19°10' 72 S 158° 34'95 E, 48 m: 37.1-12.5-10.7 mm. As before, Stn D49, 20°58' 20 S 158° 35'00 E, 48 m: shell fragments of ~ 3 specimens. 1985, Stn 443, 18° 00' S 162° 55' E, Atoll Huon, 40 m, 25Feb: >>50 mm. Stn 465, 45 m, 18° 22' S 163° 05' E, Atoll de Surprise, 01Mar: 19.4-7.1 ? mm. Stn 469, 18° 29' S 163° 15' E, Atoll de Surprise, 39 m, 01Mar: 14.6-5.7-5.4 mm. Lagon Nord, Stn 480, 18° 56' S 163° 29' E, 31 m, 02Mar: 19.0-7.0?-17.9-5.8-(2.6x2) mm (the latter with lips). Stn 483, 19° 01' S 163° 32' E, Lagon Nord, 33 m, 02Mar: 11.0-4.3~4, 10.4-3.9-3.6 mm. Stn 520, 19° 4' S 163° 36' E, Secteur de Yaté, 37 m, 05Mar: 48.6-13.0-11.3 mm. Stn 521, 19° 05' S 163° 38' E, Lagon Nord, 39 m, 05Mar: 20.2-6.8-? mm. Stn 551, 9 m, 23° 00' S 166° 59' E, Grand Récif Sud, 15Jul: 18.8-6.2-5.7 mm. 1986, Stn 677, 32 m, 21° 37' S 166° 22' E, Secteur de Thio, 09Aug: >27 mm. Secteur de Yaté, Stn 735, 22° 05' S 166° 57' E, 15-34 m, 12Aug: shell fragments. 1987, Grand Récif Mengalia, Stn 860, 22-27 m, 20° 42 S 165° 02 E, 13Jan87: 58.8-15.2-12.8 mm. Secteur de Pouébo, Stn 884, 20° 26' S 164° 44' E, 32 m, 14Jan87: 23.2-8.2~7.5 mm. Secteur de Pouébo, Stn 886, 20° 24' S 164° 41' E, 20 m, 14Jan87: 23.3-8.1-? mm. 1988, KS, Stn 954, 20° 31' S 164° 03' E, 15-17 m, 26Apr88: >>50>22.5-? mm. Coral 2, 1988, Stn

DW46, 21 m, 19° 19' S 158° 20' E, 23Jul: rv 23.1, 17.6, 15.8-5.9-? mm. Stn DW57, 19° 19' S 158° 50' E, 65 m, 24Jul: ~21 mm. Stn DW115, 19° 22' S 158° 38' E, 44 m, 28Jul: 17.4 mm. Stn DW156, 19° 49' S 158° 21' E, 42 m, 01Aug: ~21 mm (broken). Stn DW163, 19° 41' S 158° 16' E, 23 m, 02Aug: 19.1-6.1-? mm. Stn CP124, 19° 29' S 158° 20' E, 53-56 m, 29Jul: >25 mm. Musorstrom 6, 1989, Ride des Loyauté, Stn DW430, 20° 21' S 166° 07' E, 30 m, 17Feb89: 52.1-12.6-10.3 mm. Stn DW431, 20° 22' S 166° 10' E, 21 m, 18Feb89: 16.6-6.2-?, 15.0-4.4-(1.9 x2) mm. Stn DW432, 20° 21' S 166° 11' E, 21 m, 18Feb89: 89.0-23.0-20.3 mm. As before: broken specimen, ~ 60 mm. Stn DW433, 20° 20' S 166° 09' E, 24 m, 18Feb89: 19.7-6.0-5.7 mm (two distinct growth steps). Stn DW434, 20° 21' S 166° 09' E, 23 m, 18Feb89: 22.9-7.7-6.4 mm. Stn DW435, 20° 21' S 166° 08' E, 32 m, 18Feb89: 8.6~4-? mm. 1992, NC, Lagon d'Ouvéa, Stn 1221, 20° 29' S 166° 31' E, 10 m, 11Sep: 11.3-?-? mm. As before, Stn 1225, 18 m, 20° 36' S 166° 28' E, 07Sep: 31.4-7.7-?, rv 39.1-11.3-(4.7 x2) mm, (lv broken). As before, Stn 1226, 21 m, 20° 32' S 166° 24' E, 09Sep: >57-16.0-? mm. As before, Stn 1227, 12 m, 20° 37' S 166° 25' E, 15Sep: 26.7-7.2-6.2 mm. As before, Stn 1232, 31 m, 20° 32' S 166° 24' E, 09Sep: rv 56.4-13.7-(5.7 x2) mm. NS, Stn 1343, 7 m, 22° 17.8' S 166° 19.9' E, Récif Senez, pente interne, 07Sep: lv 14.3 mm. Lagon de Nouméa, Grand Récif Aboré 22.21' S 16.15' E, pente externe, 15-35 m, 27Nov: 15.2-5.5-5.0 mm. 1993, Ouest de l'Ile des Pins, Récif Uatoeroe, platier intérieur Est réc. 04-08Aug: 22.4-7.7-? mm. Expédition Montrouzier, TS, Stn 1240, 20° 26.5' S, 165° 14' - 15' E, entre la baie de Touho et l'Illet Atit, platier abrité, sable, herbiers, 0-2 m: rv 99.5-26.6-(11.0 x2), 98.8-23.9-20.0, 89.3-24.0-20.8, 88.0-22.4-19.1, 82.2-22.6-19.3, 66.8-16.8-14.3, 63.3-18.4-16.5, 61.5-15.5-13.0, 36.5-9.8-8.5, broken lv > 54-14.5-(5.7 x2) mm. TS, Stn 1242, 20° 46.2' S 165° 14.5' E, platier au large du wharf de Touho, marée, blocs, sable, herbiers: 77.6-18.4-14.8, 50.5-13.2-11.2, 42.1-12.0-10.2, 37.7-12.7-11.1, 29.6-10.5-9.2 (predation hole), 22.1-6.0-5.2, 18.6-5.5- 5.2 mm. TS, Stn 1255, 20° 43' S 165° 08' E, abords de l'ilot Ouao, sable, dômes détritiques, 11 m: 12.4-4.4-3.9, 7.3-3.0-2.8 mm. TS, Stn 1259, 20° 44.6' S 156° 13.7' E, Banc de Touho, tombants avec limon, 15-35 m: 37.0-10.9-9.3 mm. TS, Stn 1266, 20° 39.6' S 165° 14.7' E, Lagon Grand Récif Mengalia, pâté corallien, 10-15 m: 63.3 ~17-?, 56.6-13.5-?, 53.6-13.5-? mm. As before: rv 7.0-2.4-? mm. TS, Stn 1269, 20° 35.15' S 165° 08.1' E, Récif Doiman, pente externe, 15-20: 24.2-8.6-6.9 mm. TS, Stn 1270, 20° 45' S 165° 16.5' E, Grand Récif Mengalia, gente externe, 10-35 m: >55, >44 mm. As before: 22.4-7.4-? mm, 14.2-4.8-4.1 mm, 12.7-4.3-3.7 mm. TS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut-Fond de la Tié, tombants, sable sur dalle, 5-25 m: 26.3-8.6-7.3, 16.8-6.2-5.4, 13.0-4.3-3.4, > 11 mm. TS, Stn 1273, 20° 50.4' S 165° 22.8' E, Récif extérieur, Passe de Touho, fonds durs, taches de sable, 20 m: 82.6-21.8-17.9 (with lips), 52.5-14.6-11.8, rv 23.4-6.3-(2.8 x2) mm (distinct growth step with shell repair at ~19.5 mm; lv broken). Oct93, KS, Stn 1277, 20° 34' S 164° 16' E, Anse de Koumac (= Baie de Ouanap), fonds meubles, herbiers, 0-2 m: 41.5-12.5-10.5 mm. KS, Stn 1279, Pointe de Pandop, 20° 35' S 164° 15.5' E, marée, fonds durs, herbiers, 2-4 m:

tiny fragment. KS, Stn 1282, 20° 33.5' S 164° 13' E, Ilot Tangadiou, marée, platier d'îlot, fonds mixtes: 13.3-4.4-? mm. KS, Stn 1289, 20° 29.2' S 164° 10.2' E, Paagoumème, intertidal: 50.0-15.3~13, 48.1~17~14, 36.9-11.0-10.3 mm. KS, Stn 1290, 20° 29.2' S 164° 10.2' E, Paagoumène, marée, fonds meubles: 20.7-6.7-5.5, 15.1-4.9-4.3 mm. KS, Stn 1291, 20° 22.4' S 164° 06.8' E, Pointe de Babouillat, marée, rochers: 38.1-11.1-?, 33.9-10.5-?, 28.8-9.4-7.8, 27.6-8.1-6.4 mm. As before: 28.7, 26.3-8.0-7.2, 26.2-7.6-6.6, 25.6-7.3-5.9, 23.3-7.7-6.2, 23.3-7.4-6.6, 21.9-7.2-6.1, 21.9-6.6-5.7, 21.8-6.9-6.0, 20.8-7.7-7.5, 19.2-6.1-5.2, 18.7-5.8-4.8, 18.1-5.4-4.6, 17.8-5.9-?, 15.3-5.0-4.2, 14.4-5.4.5.1, 12.8-4.5-?, 12.0-4.9-4.4, 10.3, 10.2-3.8-3.2, 10.1-3.8-? (~robusta), 9.3-4.7-?, 4.4 mm. As before: 29.0-8.7-7.4, 28.3, 26.9-8.7-7.2, 26.2, 24.4-8.0-6.8, 23.4-6.9-5.9, 23.1-7.0-6.0, 21.8-6.9-6.0, 21.3-6.7-6.0, 20.8-6.1-5.7, 20.4-6.9-6.4, 18.7-6.2-5.6, 17.0-5.8-4.8, 16.7-5.8-4.9, 15.7-5.5-5.0, 15.7-4.7-4.4, >12, 11.7-4.3-3.7, 11.7-4.0-3.6, 10.4-3.4-2.9, 7.6-2.9-2.5, 7.2-2.5-? mm. As before: 17.8 mm. KS, Stn 1292, 20° 22.4' S 164° 06.8' E, Pointe de Babouillat, intertidal: 38.4-11.7-10.0, 38.1-10.8-8.9, 36.7-11.6-10.1, 36.5-10.2-9.1, 31.9-9.7-?, 31.0-9.4-8.0, 31.0-9.1-8.1, 28.0-8.7-<8, 27.8-9.1-8.0, 27.8-8.5-7.7 mm. As before: rv 10.1-3.5-(1.7 x2), 7.8-2.7-2.4, 7.1-2.3-?, 6.8-2.6-2.4 mm, plus 2 very small specimens (all less dark brown). KS, Stn 1303, 20° 37.7' - 38.8' S 164° 15.9-17.7' E, Lagon, parages du Plateau Karembe, sable, vaseux, blocs, 0-8 m: fragments of ? 2 specimens. KS, Stn 1312, 20° 40.4' S 164° 14.9' E, Passe de Koumac, tombant Est, suceuse fonds durs, 26-40 m: 17.4-6.4-5.6 mm. KS, Stn 1316, Grand Récif de Koumac, 20° 40.0' S 164° 11.2' E, 12 m, pente externe: rv 31.8-10.8-(4.7 x2), 18.5-5.9-4.8, ~14 mm. KS, Stn 1318, 20° 41.4' S 164° 14.8' E, Grand Récif de Koumac, pente externe, 20-30 m: 16.5-5.6-4.3, 14.5-4.3-3.5, 14.0-4.7-3.8, 12.6-4.5-3.7, 12.6-4.3-3.6, 12.5-4.7-3.6, 12.2-4.3-3.5, 12.2-4.2-3.6, 11.6-3.9-3.7 mm. As before: 34.5 mm, lv 31.7-10.8-(4.7 x2), 29.9-8.4-7.4, 27.7-~8-? mm. KS, Stn 1319, Passe Deverd, 20° 44.7' S 164° 15.5' E, 15-20 m, dalle: 10.1-4.1-3.4 mm, ? teres: 3.5 mm. 1994, Récif Kouaré, 1 m, vivant, dans un *Hydnophora* sp., 18May94: 53.4-17.5-14.6 mm, 46.8-14.4-12.4 mm. 1999, Nord NC, Stn CP1380, 18° 26.9' S 163° 12.7' E, 24-29 m, 9May: 26.6-8.9-8.2 mm. As before, Stn CP1388, 18° 23.8' S 163° 06.9' E, 40 m, 11May: lv ~25 mm. As before, Stn DW1384, 18° 24.1' S 163° 04.0' E, 47-48 m, 9May1999: 25.7-9.7-8.5 mm. Lifou 2000, SB, Stn 1406, 20° 46.85' S 167° 07.75' E, Easo, environs du wharf plaisancier intertidal, fonds durs, 10/13-14/16/18Nov: 43.5-11.9-9.9, 23.4-7.3-6.3 mm. GB, Stn 1419, 20° 55.6' S 167° 04.5' E, limon sur dalle, algues photophiles, 5 m, 10Nov: 25.0-8.4-6.7 mm. SB, Stn 1420, 20° 47.7' S 167° 09.3' E, Pointe de Chépéénéhé dalle avec couverture sédimentaire, 4-5 m, 18-19Nov: 21.8-8.3-6.6 (predation hole), 20.7-7.9-6.3, 13.0-5.0-4.4, rv ~13, 7.9-2.8-2.6 mm. SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé et la côte, sable grossier sur dalle, 4 m, 26-27Nov: 29.4-7.9-6.6 (predation hole), 27.0-10.2-9.1, 24.7-8.0-6.8, ~25, 22.7-9.6-8.0 (predation hole), 21.5-7.0-5.7, 18.8-5.8-4.9 mm, dead: rv 29.8-10.0-(4.1 x2), lv 24, rv 16.9-6.7-(3.8 x2), 17.7, rv 13.2 mm. GB, Stn 1424, 20° 54.9' S 167° 03.0' E, vers le Cap Mandé, sable fin et algues photophiles sur dalle, 4 m, 15Nov: 54.0-16.0-14.0, 35.8-

12.2-10.8 mm. As before: rv ~6.5 mm (predation hole). SB, Stn 1425, 20° 46.8' S 167° 07.2' E, Baie d'Huneté dalle, avec couverture sédimentaire, 4-5 m, 17Nov: rv ~6.5 mm. SB, Stn 1429, 20° 47.5' S 167° 07.1' E, Ouest/Sud-Ouest de la Pointe d'Easo, patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 23.6-8.4-7.4, 25.1-8.6-7.4, 21.8-8.0-7.2, 16.5-5.8-5.0 mm. As before: 39.9-14.2-12.0, lv 38.9, 38.0-13.0-10.2, 16.5-6.5-5.3, 12.3-4.7-4.5 mm. Stn 1430, as before, 20-25 m, 9Nov: rv 10.3-3.9-(1.9 x2) mm. SB, Stn 1431, 20° 47.5' S 167° 07.1' E, Ouest/Sud-Ouest de la Pointe d'Easo, récoltes à vue, 18-35 m, 3/5/7/9/17/23-24Nov: 29.7-10.0-8.8, 30.0-10.0-8.7, 27.1-10.2-7.2, 42.2-13.5-12.3, 31.6-10.6-8.9 mm. SB, Stn 1434, 20° 52.5' S 167° 08.1' E, entre l'îlot Huca Hutighé, fonds durs, 5-20 m, 06Nov: 21.7-8.1-6.8 mm. As before: 48.1-14.5-12.1, rv 40.2-13.4-(5.3 x2), 37.3-14.0-11.6, 9.1-3.2-2.8, + 6 valves. SB, Stn 1435, 20° 55.2' S 167° 00.7' E, Pointe Lefèvre tombants verticaux et surplombs, 5-30 m, 8Nov: 27.6-9.7-8.3, 13.0-5.1-? mm. GB, Stn 1436, 20° 55.5' S 167° 04.2' E, patate corallienne sur tombant, 10-20 m, 10Nov: 27.1-10.3-9.4 (predation hole), 24.4-8.3-7.3 mm. As before: 47.8-11.8-9.8, rv 32.6, lv 20.2-7.9-(3.3 x2), 17.1-5.3-4.9 mm. SB, Stn 1444, 20° 55.0' S 167° 05.2' E, NE de la baie de Gaatcha pente alternant zones caillouteuses 'mortes' et passées sableuses grossières, 9-20 m, 15/26Nov: lv >13.5, lv > 11 mm. SB, Stn 1446, 20° 50.8' S 167° 09.7' E, Est de la Baie du Santal, Mepinyo, bas du tombant, 36-40 m, 16Nov: 52.5-13.3-10.8 mm. SB, Stn 1450, 20° 45.8' S 167° 01.65' E, au Nord du Cap Aimé Martin, brossages, 27-31 m, 17/21Nov: 34.7-11.5-9.5, 7.8-2.8-2.6, (dead) 15.4-5.6-4.8 mm. Stn 1451, 20° 47.3' S, 167° 06.8' E, Ouest de la Pointe d'Easo, 2^{eme} patate corallienne, 10-21 m, 19Nov: 20.0-6.6-5.5 mm. As before: 26.0-8.8-7.6 mm, 21.7-7.9-6.8 mm, 19.3-7.3-5.9 mm. SB, Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: 27.0-9.4-8.1, 24.3-9.7-8.4, 18.7-7.0-6.0 mm. As before: 24.4-10.0-8.0, 21.2-6.9-5.8, 20.7-7.8-6.6, 20.7-7.3-6.1, >18.5, 18.3-7.8-6.7, 17.2-6.7-?, 15.5-5.5-4.5, 15.4-6.3-5.1, 14.7-5.7-4.9 (predation hole), 12.8-4.7-3.7, 11.0-3.9-3.4, 9.6-3.3 3.0 mm. SB, Stn 1456, 20° 49.3' S 167° 10.4' E, NE de la Baie, au niveau de Cila, tombant, 25-30 m, 26Nov: 43.4-11.0-8.7, 36.0-9.5-7.6, 19.7-5.5-4.4, 17.4-5.9-5.1, 9.1-3.1-2.9 mm (empty shells: 25.8, 35 mm, + 9 valves). SB, Stn 1458, 20° 46.7' S 167° 03.1' E, En face de la plage de Ngoni, dragages, 17-24 m, 4Nov: 38.0-12.5~10, 28.5-10.1-9.2 mm. SB, Stn 1459, 20° 47.0' S, 167° 03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 42.9-14.8-13.3 mm (predation hole). As before: 25 mm (dead). As before: 107.3-28.4-22.5, 41.7-15.1-12.0, 29.0-9.0-7.9, ~32, 23.7-8.3-7.4, 21.5, 19.5-6.1-5.4, 16.2-5.1-4.4; dead: rv 55.3-17.7-(7.4x2) (predation hole), >48, 38.3-11.8-10.4 (predation hole), 37.5-12.6-10.9, 36.0-12.3-10.6 (predation hole), 35.8-11.7-10.2 (predation hole), 44.7 (predation hole), rv 35.6-11.0-(4.7x2) (predation hole), rv 30.5-10.3-(4.2x2), 25.3-9.1-8.1, rv ~26 mm, lv >22, lv >21, lv 20.9-8.6-(3.7x2) (predation hole), rv 18.7, 13.0-4.0-3.8, rv 9.8, 7.4 mm. SB, Stn 1460, 20° 52.4' S, 167° 08.0' E, Est de la baie, devant l'îlot Huca Hutighé, dragages, 40-60 m, 06Nov: 23.2-7.6-6.9, 18.7-6.3-4.9 mm. As before: 69.3-~25-?, lv 51.3 (predation hole), lv 39.7 (predation hole),

rv 30.3 mm, 25.3, lv ~22.5, rv 20.0-8.1-(3.3 x2), 10.1-4.0-3.6 (no striae), ~ 7 mm (predation hole in left umbo), plus some more small shells and fragments. GB, Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sables et débris coralliens, 20-30 m, 10Nov: 39.9-11.1-9.0, 37.8, >36, ~34.5-9.3-7.7 mm. As before: 63.6-18.1-14.6 mm, 63.4-18.4-15.6 mm, 24.8-6.8-6.0 mm, 17.2-6.4-5.5 mm, 16.2-4.5-3.7 mm, 15.0-5.0-4.3 mm; empty shells: 36.8-9.3-? mm, lv 31.0-11.1-(4.8 x2) mm, >30 mm, rv 29.1-8.9-(3.9 x2) mm, 28.6-9.8-8.2 mm, lv >26.5-7.1-? mm, rv 22.5 mm. SB, Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 29.3-8.0-7.1, 23.5-7.1-6.1 mm (empty). As before: in dead coral *Porites* (+ more Lithophaginae boreholes, some lined). As before: lv 28.6-10.3-(4.5 x2), 23.1-7.6-6.5, rv 16.5-5.0-(2.3 x2) mm. As before: 43-11.8-9.8, 40.3-12.0-10.4, 21.6-7.2-6.1, 19.6, 18.3, 16.7-6.0-5.0, 16.5, 14.2-4.5-4.2, 13.3 mm. SB, Stn 1465, 20° 47.7' S 167° 07.0' E, de part et d'autre de la Pointe d'Easo, dragages, blocs et coraux, 35-44 m, 16Nov: 24.0-7.3-5.9, 20.3-7.3-6.0, 20.3-6.0-5.5, 17.3-6.9-6.0 mm. As before: 38.9-12.8-9.9 mm, 32.6-10.6-9.7 mm, 19.3-6.3-4.9 mm, + valves of dead specimens. SB, Stn 1466, 20° 46.5' S 167° 06.2' E, Baie d'Hunetë, dragages, blocs coralliens, 25-45 m, 17Nov: 23.8-8.0-7.1, 16.1-6.6-6.3 mm, dead: >30.9-?-?, lv >28, rv 17.9, 16.9-5.5-4.7, 16.5-5.5-4.6, rv 15.0-5.8-(2.5 x2), lv 13.6-4.0-? mm. SB, Stn 1467, 20° 46.6' S 167° 05.4' E, devant Hunetë, dragages, 90 m, 20Nov: lv 42.5-13.2-(5.8 x2), 32.8-11.1~10, >27 mm, 17.6-6.9-6.3 mm (no striae, ~*Botula*). SB, Stn 1468, 20° 46.5' S 167° 05.7' E, devant Hunetë, dragages, 30-80 m, 20Nov: ~22 mm. SB, Stn 1469, 20° 54.2' S 167° 00.4' E, devant le Cap Lefèvre dragages, 70-130 m, 22-23Nov: 18.4-7.1-6.4 mm. Philippines, Panglao 2004, PI, Stn B14, 9° 38.5'N, 123° 49.2'E, Sungcolan Bay, coral rubble, 2-4 m, 16Jun: 8.9 mm. Pamilacan Island, Stn B22, 9° 29.4' N, 123° 56.0' E, rubble on mixed bottom, 15-20 m, 24Jun: 18.7-4.9-4.1 mm (Kleemann 2010: 500, pl. 941, fig. 1b). BAI, Stn B23, 9° 31.1'N, 123° 41.3'E, Black Forest, rubble on sand, 20-25 m, 25Jul: 9.1-3.0-2.7 mm. BAI, Stn L42, 80-90 m, 9° 31.2'N, 123° 40.7'E, 02Jul: 16.8, 10.3 mm, both disarticulated. PI, off Momo Beach, Stn L76, 9° 36.5' N, 123° 45.3' E, ca. 80 m, 2005-06: 6.5-4.3-3.2 mm.

Lithophaga ? *teres*: New Caledonia, Ile des Pins, Stn 592, 22° 34' S 167° 22' E, 22 m, 18Jul85: 15.5 mm (+ predation hole). Expédition Montrouzier, TS, Stn 1259, 20° 46.6' S 165° 13.7' E, Banc de Touho, tombants avec limon, 15-35 m.; lv 35.6 mm, 13.1-4.0-? lv mm. TS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut- Fond de la Tié, tombants, sable sur dalle, 5-25 m: 25.0-8.4-5.8, 17.9-6.0-5.1, 15.5-5.1-4.2 mm, middle brown (? bleached). TS, Stn 1273, 20° 50.4' S 165° 22.8' E, Récif extérieur, Passe de Touho, fonds durs, taches de sable, 20 m, Sep93: lv 6.2, 3.6 mm (very light brown), + 2 minute right valves. KS, Stn 1291, 20° 44.7' S 164° 15.5' E, Passe Deverd, dalle, 15-20 m: 7.1-3.0-2.8 mm (dead). Oct93, KS, Stn 1298, 20° 35' S 164° 16.6' E, Pointe de Pandop, fonds durs, 2-4 m: lv <6 mm. KS, Stn 1299, Lagon entre la terre et l'Infernet, 20° 34.4' S 164° 13.0' E, 12-14 m, dalle à Gorgones, limon: lv ~4 mm. KS, Stn 1311, 20° 40.4' S 164° 14.9' E, Passe de

Koumac, tombant Est, fonds durs, 10-60 m: ~ 5 mm. KS, Stn 1318, 20° 41.4' S 164° 14.8' E, Grand Récif de Koumac, pente externe, 20-30 m, Oct93: ~ 6 mm, fair coloured, no obvious striae. Lifou 2000, SB, Stn 1462, 20° 47.1' S 167° 03.2' E, Arrête au SE de la Pointe Aimé Martin dragages, 70-120 m, 9/21Nov: 11.0-4.8-4.3 mm. SB, Stn 1469, 20° 54.2' S 167° 00.4' E, devant le Cap Lefèvre dragages, 70-130 m, 22-23Nov: 11.1-5.1-4.2, lv 10.7-4.5-(1.9 x2) mm.

Diagnosis

Black *Lithophaga* s.s.

Description

Shell subcylindrical, usually slender without a conspicuous dorsal angle, smooth dorso-latero-posteriorly, but with vertical striae ventro-latero-anteriorly, periostracum generally black or dark brown, free from own calcareous deposits. Umbos almost terminal, anterior elevated similar to *nasuta*, ventral line straight, posterior rim semicircular, may develop an inner edge (Kleemann 1984: p. 211, fig. 20 left). Ligament rather short.

Remarks

As pointed out in the synonymy, in the view of Kleemann there is only one black species of *Lithophaga* s.s. with geographically and locally different size ranges, due to differences in food resources (see discussion). Maximum length observed 134.7 mm (Kleemann 1984: p. 211). Within the present material, variation in shape is striking, shell length reaches about 120 mm. The depth range is wide, with live specimens found from the intertidal to dredged substrates from 70-120 m.

Leiosolenus Carpenter, 1856: 130.

Type species, *Lithodomus* (*Leiosolenus*) *spatiosus* Carpenter, 1856: 130-131.

As *Lithophaga* but lacking striae and more or less covered with species-specific calcareous deposits, borehole commonly (partly) lined.

Lithophaga (*Leiosolenus*) *canalifera* (Hanley, 1843)
(Figs 1A-C)

Modiola (*Lithodomus*) *canalifera* Hanley, 1843: p. 239 (1855: pl. 24, fig. 22).

Lithodomus canaliferus Han. - Reeve, 1857: sp. 25, pl. 4, fig. 25.

Lithophaga canalifera Han. - Dunker, 1880-83: 11 (1883), pl. 1, fig. 1-2 (1880). Kühnelt, 1930: pl. 10, fig. 26 (from Dunker, 1880). Kleemann, 2010: p. 502, pl. 942, fig. 4a, b.

Types

Lectotype, NHMUK 1907.10.28.52, 39.3-11.9-11.2 mm. Paralectotype, NHMUK 1907.10.28.53, 26.3-9.5-9.1 mm (Kleemann 1983: pp. 4, 5). Type locality, Isle of Cebu, PH.

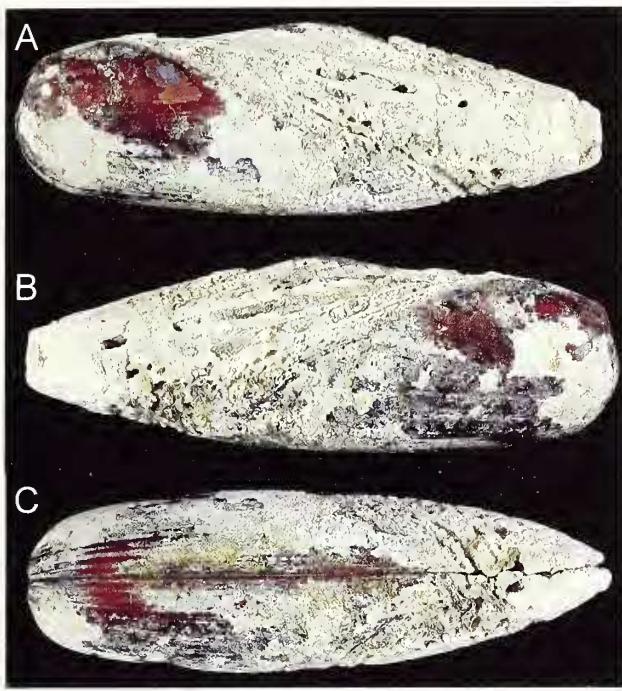


Fig. 1. *Lithophaga (Leiosolenus) canalifera* (Hanley, 1843), 38.3-12.8-12.0 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 0-1 m, intertidal to shallow subtidal, Alona Beach, Panglao Island, Philippines, 9° 32' 9" N, 123° 46' 6" E, Stn M1, May-Jul04. Images by P. Maestrati, MNHN.

Fig. 1. *Lithophaga (Leiosolenus) canalifera* (Hanley, 1843), 38.3-12.8-12.0 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 0-1 m, da intertidale a subtidale superficiale, Alona Beach, Panglao Island, Filippine, 9° 32,9' N, 123° 46,6' E, Stazione M1, Maggio-Luglio 2004. Foto P. Maestrati, MNHN.

Material examined

Philippines, Panglao 2004, Stn M1, Panglao Island, Alona Beach, 9° 32.9' N, 123° 46.6' E, intertidal to shallow subtidal, 0-1 m: 38.3-12.8-12.0 (**Fig. 1A-C**), 36.2-11.2-10.1, 29.5-10.2-8.8, 28.8-10.1-8.5 mm, dead: lv 33.0 (rv 32.5, shell only ~25.5)-10.4->9 mm.

Diagnosis

Leiosolenus, incrustation forming diagonally stretched ridges, separated by similar-sized furrows.

Description

Shell up to 40 mm long, with protruding incrustation, periostracum dark brown, mainly covered by calcareous deposits, which in the dorso-posterior section form elongated, straight ridges of increasing thickness, separated by channel-like furrows, both running diagonally from past the umbos latero-posteriorly to the postero-ventral, attenuated extremity. Furrows only partly free from further deposits.

Remarks

This species developed an extensive posterior incrustation, visible in the prolongation of a 25.5 mm long shell by about 7 mm. Most likely it is a dead substrate borer in an environment with a generally high erosion rate

and/or turbidity. Bernard et al. (1993) erroneously note the species as 'Hanley, 1841'.

Lithophaga (Leiosolenus) dahabensis Kleemann, 2008

Lithophaga purpurea (part) Kleemann - Kleemann, 1995, tab. 1, only from host coral *Stylococciella guentheri* (Basset-Smith, 1890).

? *Lithophaga lifouensis* n.n. - Kleemann, 2004: p. 30.

Lithophaga (Leiosolenus) dahabensis Kleemann, 2008: pp. 40-43, figs 4A-D.

Types

Holotype, IPUW 200800020001, 16.2-6.9-6.2 mm. Four paratypes, IPUW 200800020002-5, 12.5-6.2-5.6 mm, 10.6-5.5-4.8 mm, 13.0-5.8-5.3 mm, 12.3-5.6-5.0 mm, respectively. Type locality, reef slope at Rick's Reef at 16.5 m depth, north of Dahab, Sinai Peninsula, northern Red Sea. Host coral, *S. guentheri*.

Material examined

French Polynesia, Austral Islands, Tubuai, n° 29 123 69, 100 m, réc. Y. Plessis, May79: 17.8-7.6-6.7, 14.3-6.4-5.4, 13.6-5.6-5.1, 12.0-5.8-5.1, 11.6-5.7-4.7, 11.1-5.1-4.4, 10.5-4.6-4.0, 5.5-2.6-2.5 mm; dead: rv 19.9-8.1-(3.5x2), 17.7-7.3-6.2, 17.3-7.4-6.7, ? 12.0-4.9-3.8, lv 15.2-6.6-(2.7x2), lv 13.3-5.1-(2.2x2), 10.1-4.7-4.0 mm. Bathus 1 cuise, Stn DW692, 20° 35' S 164° 59' E, 140-150 m, 17Mar93: ? *dahabensis*, rv 15.5-6.4-(2.8 x2) mm. N Lifou 2000, Stn 1459, 20°47.0' S, 167°03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 15.7-6.8-6, 14.4-6.7-5.9, 14.5-6.2-5.2, 14.1-6.1-5.2, 14.0-6.4-5.8, 13.7-6.2-5.5, 13.6-6.0-5.1, 12.1-5.5-4.9, 10.5-5.1-4.7, 10.0-4.7-4.1, 10.0-4.4-3.7, 9.4-4.5-3.9 mm. As before: 19.5-7.9-7.0, 18.1-7.4-7.1, 17.1-7.3-5.9, 16.7-7.5-6.7, 16.3-7.2-6.5, 16.2-7.3-5.9, 16.2-6.8-6.1, 16.1-7.1-6.0, 16.0-7.2-5.9, 15.5-6.9-5.6, 15.5, 15.2-6.6-5.5, 14.9-6.2-4.9, 14.8-6.6-5.6, 14.6-7.0-6.0, 14.5-6.7-6.0, 14.2-6.1-5.4, 14.0-6.5-5.6, 14.0-6.5-5.3, 14.0-5.9-5.0, 13.7-6.1-5.3, 13.7-5.6-5.2, 13.6-6.1-5.1, 13.5-6.0-4.9, 13.5-5.6-5.2, 13.2-6.1-4.9, 13.2-5.8-1, 12.9-5.9-4.7, 12.6-5.6-5.0, 13.0-6.0-5.0, 13.0-5.9-4.9, 12.8-5.5-4.7, 12.6-5.7-4.8, 12.3-5.6-4.9, 12.1-5.5-4.7, 11.9-6.2-5.1, 11.9-5.2-4.5, 11.9-5.0-4.3, 11.7-5.7-5.1, 11.7-5.3-4.7, 11.7-5.3-4.5, 11.5-5.3-4.8, 11.2-5.5-4.5, 11.1-5.3-4.6, 11.0-5.3-4.2, ~11, 10.8-5.2-4.5, 10.8-4.8-4.2, 10.7-5.0-4.3, 10.0-4.8-3.9, 10.0-4.6-3.8, 10.0-4.3-3.6, 9.6-4.3-3.5, 9.4-4.3-3.7, 9.3-4.2-3.6, 9.1-4.9-4.2, 8.6-4.3-3.8, 8.4-4.4-3.7, 8.4-3.9-3.7, 7.4-3.8-3.4, 7.1-3.7-3.1, 6.0-3.0-2.5 mm; dead: 17.1-6.9-6.0, 16.8-7.5-6.3, 14.8-6.6-5.4, 14.7-6.8-5.9, 14.6-6.3-5.5, 14.3-6.7-5.9, lv 14.5-6.2-(2.2x2), 13.8-6.0-5.3, lv 13.2-5.7-(2.6x2), lv 13.1-5.5-(2.6x2), lv 12.6-5.5-(2.1x2), 12.6-5.5-5.2, rv 12.5-5.7-(2.3x2), rv 12.5-5.6-(2.2x2), rv 12.4-5.7-(2.7x2) (predation hole anteriorly), rv 11.7-5.5-(2.4x2), rv 11.6-5.3-(2.2x2), 11.3-5.5-5.1, lv 11.3-5.3-(2.5x2), rv 11.1-5.2-2.1x2), rv 11.1-4.8-(2.3x2), 11.0-5.1-4.2, ~11, lv 10.3-4.9-(2.1x2), rv 10.2-5.0-(2.2x2), lv 10.1-5.0-(1.9x2), lv 9.7-4.4-(1.7x2), lv 9.1-4.4-(2.0x2), rv 9.7-4.7-(1.8x2), lv 8.5-3.7-(1.7x2), lv 8.1-3.9-(1.7x2), 8.0-4.0-(1.8x2), rv 7.5-3.8-(1.7x2), lv 7.7-3.6-(1.6x2), rv 7.6-3.6-(1.6x2), lv ~3.5 mm. Stn 1461, 20° 54.0' S, 167° 02.1'

E, Récif Shelter, dragages, 100-120 m: 12.4-5.8-4.7 (predation hole in posterior rv), 12.2-5.7-4.8 mm. Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: rv 14.9-6.8-(3.1 x2) mm. As before: 12.2-5.3-4.5 mm. Stn 1465, 20° 47.7' S 167° 07.0' E, de part et autre de la Pointe d'Easo, dragages, blocs et coraux, 35-45 m, 16Nov: 15.2-7.3-6.5, 14.4-7.7-5.9, 13.7-6.8-5.5, 11.5-5.2-4.7, ? lv >8-4.5-(2.2 x2) mm. Stn 1467, 20° 46.6' S 167° 05.4' E, devant Hunetë, dragages, 90 m, 20Nov: 14.1-6.2-5.2 mm (note semi-circular predation hole on posterior extremity of rv). Vanuatu, Santo 2006, Palikulo Bay, Stn DB69, 15° 24.4' S, 167° 13.0' E, 38 m, sand and coral patches, 27Sep: ? *dahabenensis*, rv 8.1-4.3-(1.9x2) mm.

Diagnosis

Small and stout, dorsal angle prominent, posterior shorter and lacking any incrustation, coral associate.

Description

Shell probably up to 20 mm long, robust, high and wide for its size, umbos almost terminal, ligament long, posterior dorsal line sloping slightly curving to the rounded to somewhat truncated end, ventral line gently convex, periostracum in shades of brown to purplish, with a darker stripe latero-posteriorly, free of any significant incrustation, but often covered by soft deposits of presumably mainly detritus, aggregated in mucus secretions of the bivalve. Concentric growth lines may be prominent towards the posterior, otherwise smooth.

Remarks

This species was recently described in detail from the northern Red Sea, so far known only from live *S. guentheri* (Kleemann, 2008). The type of substratum inhabited at Lifou is not recorded.

Lithophaga (Leiosolenus) divaricalx Iredale, 1939 (Fig. 2A-C)

Lithophaga (Salebrolabis) divaricalx Iredale, 1939: pp. (417, 418), 420, pl. 6, fig. 23. Soot-Ryen 1955: p. 94 = *Lithophaga* (Diberus). Wilson, 1979: p. 437. Kleemann, 1983: p. 9.

Lithophaga divaricalix (sic) Iredale - Soot-Ryen, 1969: N276, type of *Salebrolabis* Iredale, 1939.

Lithophaga (Diberus) divaricalx Iredale - Wilson, 1979: pp. 473, 474, fig. 18/1a-b (holotype). Kleemann, 1984: p. 193, figs 1, 2 (holotype).

Lithophaga (Leiosolenus) divaricalx Iredale - Kleemann, 2010: p. 502, pl. 942, fig. 6.

Leiosolenus (Diberus) divaricalx (Iredale) - Huber, 2010: p. 120, left figure in 3rd row.

Type

Holotype, AM C60401, 43.8-17.6-15.0 mm (Kleemann, 1984: figs 1, 2). Type locality, Low Isles, Queensland.

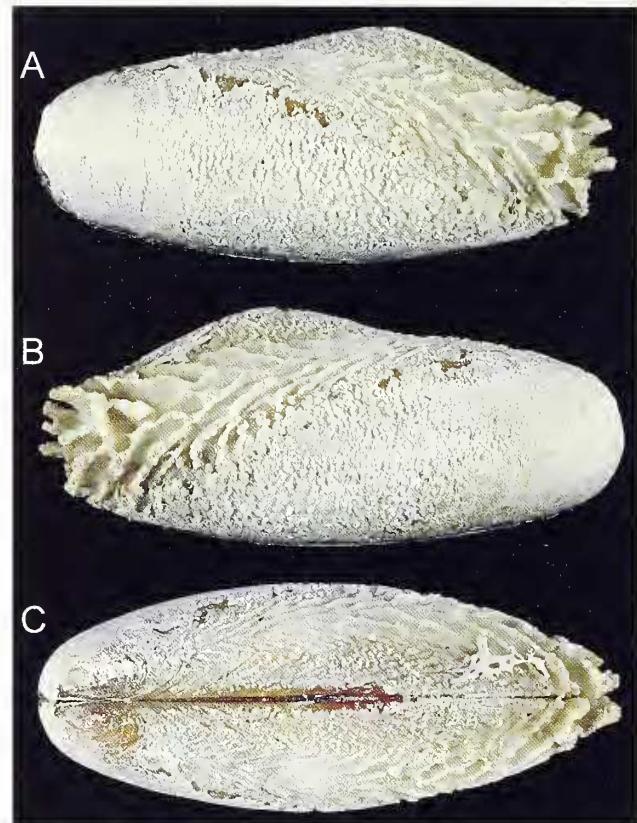


Fig. 2. *Lithophaga (Leiosolenus) divaricalx* Iredale, 1939, 23.6-9.7-9.2 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 24 m, reef slope with overhangs, BBC Point, Panglao Island, Philippines, 9° 33.2' N, 123° 48.3' E, Stn B4, 01Jun04. Images by P. Maestrati, MNHN.

Fig. 2. *Lithophaga (Leiosolenus) divaricalx* Iredale, 1939, 23.6-9.7-9.2 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, da 24 m, scarpata di scogliera con strapiombi, BBC Point, Panglao Island, Filippine, 9° 33.2' N, 123° 48.3' E, Stazione B4, 1 Giugno 2004. Foto P. Maestrati, MNHN.

Material examined

Phillipines, Panglao 2004, Stn B4, 9° 33.2' N, 123° 48.3' E, reef slope with overhangs, 24 m, 01Jun04: 23.6-9.7-9.2 mm. Bohol Island, W of Baclayon, Stn T6, 9° 35.1' N, 123° 51.2' E, coarse muddy sand with large sponges, 34-82 m, 02Jun04: 23.4-9.8-8.7 mm (Fig. 2A-C).

Diagnosis

Shell with a high dorsal angle, short, posterior subtriangular, covered by a rough plumose incrustation.

Description

Shell shape differs from the usually subcylindrical form by (1) a prominently elevated dorsal angle, (2) a distinctly shorter posterior than anterior, resulting in a steeper posterior than anterior dorsal line, and (3) a convex ventral line. The straight hinge (ligament) exceeds half the shell length, umbos subterminal, periostracum brown, mainly covered by calcareous deposits, latero-posterior incrustation very rough, composed of chevrons, more plumose than reticulate, protruding not very far beyond shell rim.

Remarks

So far, the holotype is the largest known specimen of this rare species, previously recorded from Low Isles, Queensland, Peak Island, Western Australia, and Quezon, Philippines (Wilson, 1979: p. 473).

Lithophaga (Leiosolenus) hanleyana (Reeve, 1857) (Fig. 3A-C)

Lithodomus hanleyanus (Dunker MS) Reeve, 1857: sp. 19, [non pl.4, fig. 19 (? *malaccanus* Reeve, 1857)]. Kühnelt, 1930: pl. 4, fig. 2. Kleemann, 1984: fig. 3 (lectotype).

Lithophaga hanleyana Dunker, 1880-83: pp. 20, (30, 31), pl. 5, fig. 8. Non *L. hanleyana* Reeve - Otter, 1937: pl. 1, fig. 1/7. = *laevigata* (Quoy & Gaimard, 1835), and when quoted from live coral, p. 345 (Kleemann, 1980a: p. 25).

Lithophaga (Doliolabis) laevigata instigans Iredale, 1939: pp. 417, 422, pl. 6, fig. 27. Allan, 1950: p. 294, text-fig. 69/6. Wilson, 1979: fig. 17/3a, b (holotype), = *hanleyana* Reeve. Kleemann, 1984: figs 7, 8 (holotype) = (*Labis*) *hanleyana*.

Non *L. hanleyana* Dunker - Gohar & Soliman, 1963a: pp. (65, 67, 68, 73, 78), 82-91, (93, 95), text-figs 8A, B, 910, 11A, B, (12, 13), pl. 1, fig. 1 (middle), pl. 2. Soliman 1969: pp. (887, 888, 889, 890, 891), text-figs 1B, 2B, C.

Non *L. hanleyana* Gohar & Soliman - Kleemann, 1977: pp. (151, 152, 153, 154), figs 1a, 5-6. = *laevigata* (Kleemann 1980a: p. 25).

Lithophaga hanleyana Reeve - Wilson, 1979: pp. (437, 438, 439), 470-473, (477, 478, 486), text-fig. 14a-c, fig. 17/3a-b, 4a, non 4b-d (Kleemann, 1984: pp. 194-196). Morton & Scott, 1980: pp. (179, 180, 181, 182, 183, 184, 185, 186, 187, 191, 193, 195), pl. 1, fig. 1.

Lithophaga (Labis) hanleyana (Reeve) - Kleemann, 1984: pp. 193-199, fig. 3 (lectotype). Non *Leiosolenus hanleyanus* - Oliver

1992: pp. 47, 55, 228, text-fig. 28a, b, pl. 7, fig. 9a, b. Oliver, 1995: fig. 963 = *malaccana* (Reeve, 1857).

Lithophaga (Leiosolenus) hanleyana (Reeve) - Kleemann, 2010: p. 504, pl. 943, figs 3, 4.

Types

Lectotype, NHMUK 197589/1, 32.7-11.0-9.5 mm (Kleemann 1983: p. 11; 1984: p. 193, fig. 3). Type locality, Suez. AM C.60405, holotype of *laevigata instigans* (Kleemann 1984: p. 193, figs 7-8), 43.0-13.6-12.0 mm. Type locality, Low Isles, Queensland.

Material examined

French Polynesia, Society Islands, Moorea, Tiahura, 1982: 27.3-9.4-7.6 mm (Fig. 3A-C). NC, île Ouen, Baie de Prony, Stn 160, 22° 36' S, 166° 37' E, 10 m, 24Aug84: 13.8 mm (broken). Moorea (radiale de Tiahura), arrière platier du récif barrière, 1986: 22.3, ~17.5, ~16, 16.0 mm. Tuamotu Islands, Takapoto Atoll, platier extérieur, 1992: 32.2-11.7-8.8, 21.6 mm. NC, Lifou 2000, SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé, et la côte sable grossier sur dalle, 4 m, 26-27Nov: 30.3-9.5-8.0, rv 28.6-10.1-(3.8 x2), rv 16.1-5.4-(2.3 x2) mm. Philippines, Panglao 2004, North of Doljo, Stn B35, 9° 35.9' N, 123° 44.5' E, 31 m, reef wall, 01Jun: 10.3-4.1-3.8 mm. PI, Napaling, Stn M22, 9° 37.2' N, 123° 46.4' E, coral platform, 0-3 m, 15Jun: 19.8-6.8-5.6, ~18.5 mm. Stn M24, Manga Point, 9° 42.1' N, 123° 51.3' E, mangrove and mixed intertidal, 0-1 m, 17Jun: 26.4-9.2-7.8 mm (Kleemann 2010: pl. 943, fig. 3). Vanuatu, Santo 2006, Palikulo Peninsula, Stn VM58, 15° 28.6' S, 167° 15.3' E, intertidal, 07Oct: 21.1-6.9-?, rv 19.8-6.7-(3.9x2) mm.

Lithophaga ? *hanleyana*: New Caledonia: Expédition Montrouzier, Stn 1240, entrance to Touho Bay and Atit Islet, 20° 46.5' S 165° 14'-15' E, platier abrité, sable, herbiers, 0-2 m: 30.5~10.5-? mm (note truncated posterior covered by a solid incrustation, composed of a series of 'lips' with a median point-like protrusion; the last pair of lips protrude beyond the shell rim for a relatively short distance (Fig. 4). Stn 1242, Platier au large du wharf de Touho, 20° 46.2' S 165° 14.5' E, intertidal: 28.2-9.4-7.9 mm, ? *lithura*. PH, Panglao 2004, Balicasag Island Stn B41, 9° 30.9' N, 123° 40.8 E, 17-19 m, floor of large cave, 04Jul: 7.7 mm (could be *subattenuata* n. sp.). Vanuatu, Santo 2006, Palikulo Bay, Stn FB43, 15° 28.4' S, 167° 14.9' E, massive dead corals, 19 m, 30Sep: 18.5-6.9-<6.5 mm (? big *subattenuata* n. sp.)

Diagnosis

Shell with a thick, smooth posterior incrustation, forming broad, concave lips, with a median tip (Kleemann, 1984: figs 3, 7, 8).

Description

Shell subcylindrical, smooth, up to 40 mm long, ante-

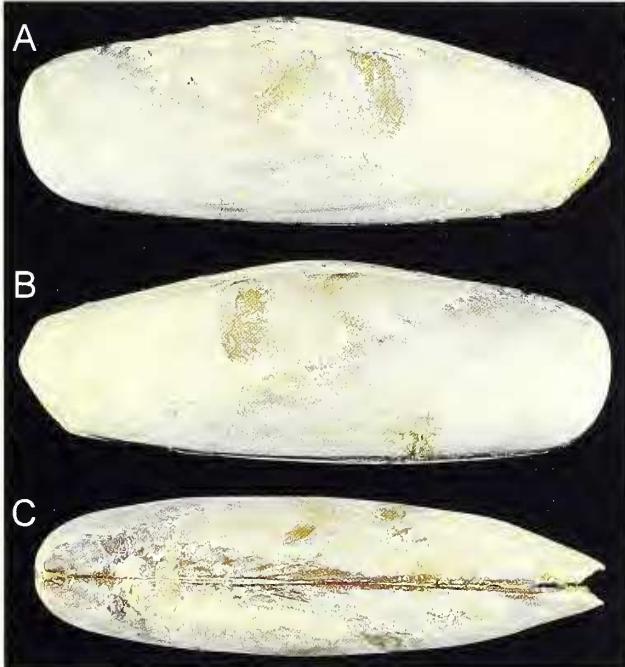


Fig. 3. *Lithophaga (Leiosolenus) hanleyana* (Reeve, 1857), 27.3-9.4-7.6 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, da SI, Moorea, Tiahura, coll. G. Richard, 1982. Foto P. Maestrati, MNHN.

Fig. 3. *Lithophaga (Leiosolenus) hanleyana* (Reeve, 1857), 27.3-9.4-7.6 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, da SI, Moorea, Tiahura, coll. G. Richard, 1982. Foto P. Maestrati, MNHN.



Fig. 4. Right lateral view of *Lithophaga (Leiosolenus) ? hanleyana*, 30.5-10.5-? mm, from 0-2 m, sheltered platform, sand, seagrass, entrance to Touho Bay and Atit Islet, NCTS, 20° 46.5' S 165° 14'-15' E, Stn 1240, EM Sep93. Note truncated posterior, posterior incrustation composed of a series of median pointed 'lips'. Image by P. Maestrati, MNHN.

Fig. 4. Right lateral view of *Lithophaga (Leiosolenus) ? hanleyana*, 30.5-10.5-? mm, from 0-2 m, piattaforma riparata, sabbia, prateria, ingresso a Touho Bay e Atit Islet, NCTS, 20° 46.5' S 165° 14'-15' E, Stazione 1240, EM Settembre 1993. Si noti il lato posteriore troncato, e l'incrostazione posteriore formata da una serie di "labbra" mediane appuntite. Foto P. Maestrati, MNHN.

rior end hemispherical, posterior half only minimally attenuated, the end broadly truncated, the incrustation not far protruding, smooth and compact, usually forming a pair of wide lips, with elevated outer, rather sharp-edges, bearing a median tip. For more details see Kleemann (1984: p. 193).

Remarks

The lectotype, NHMUK 197589/1, was selected from three ? syntypes because it was the only complete specimen and the other two ? syntypes belong to *L. ? malaccana* (Reeve, 1857), NHMUK 197589/2, and *L. ? laevigata* (Quoy & Gaimard, 1835), NHMUK 197589/3, respectively (Kleemann 1984: 194, figs 4-6). In outline and form of the posterior incrustation, the present specimens seem to be intermediate between more slender and less dark pigmented *hanleyana* from the Great Barrier Reef of Australia and Japanese specimens of *L. lithura* Pilsbry, 1905. The latter have a broad, truncated and purple posterior shell rim, and a striking middle spur terminating the incrustation (Pilsbry, 1905: pl. 5, figs 37-39). Therefore, one might consider *hanleyana* (type locality Suez), distributed from the Red Sea to the Great Barrier Reef of Australia, as grading on its further route to Japan into *L. lithura*. This is visible in an increasingly pronounced shell truncation as well as in the posteriorly increasing elongation of the middle spur.

Lithophaga (Leiosolenus) laevigata (Quoy & Gaimard, 1835) (Fig. 5A-C)

Lithodomus levigatus Quoy & Gaimard, 1835, type material only (Kleemann, 1980a: p. 25).

Non *Lithodomus levigatus* Quoy & Gaimard, 1835: pp. 464, 465, pl. 78, figs 17, 18 (Kleemann, 1980a: p. 25).

Lithophaga hanleyana Reeve (pars) - Otter, 1937: p. 346, only when quoted from live coral, pl. 1, fig. 1. Gohar & Soliman, 1963a: pp. 82-91, text-fig. 8A, B, pl. 1, fig. 1 (middle), pl. 2 (?). Soliman, 1969: pp. 887-890, figs 1B, 2B, 2C.

L. (Leiosolenus) hancocki Soot-Ryen - Keen, 1971: p. 68, text-fig. 141.

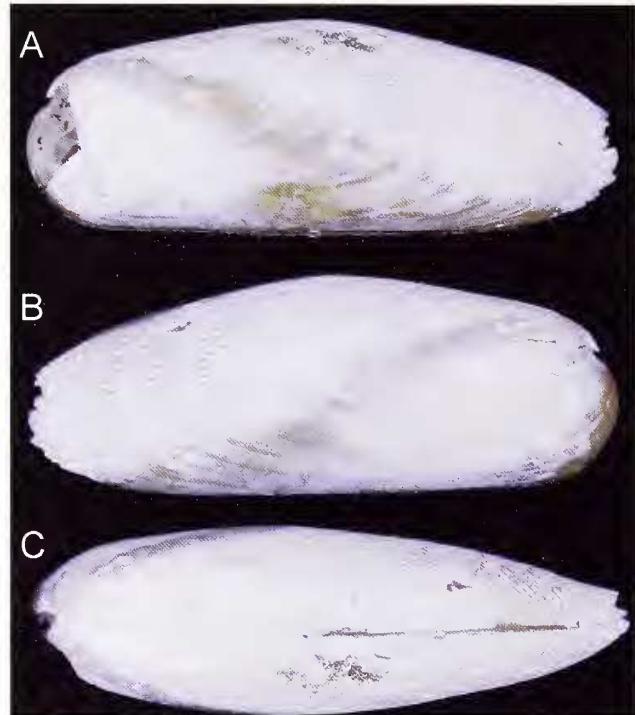


Fig. 5. *Lithophaga (Leiosolenus) laevigata* (Quoy & Gaimard, 1835), 11.2-4.1-3.5 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, 1-5 m, fringe mangrove, sand and seagrass, Sungolan Bay, Pangalo Island, Philippines, Stn R26, 9° 38.5' N, 123° 49.7' E. Images by P. Maestrati, MNHN.

Fig. 5. *Lithophaga (Leiosolenus) laevigata* (Quoy & Gaimard, 1835), 11.2-4.1-3.5 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 1-5 m, margine del mangrovieto, sabbia e vegetazione marina, Sungolan Bay, Pangalo Island, Filippine, Stazione R26, 9° 38,5' N, 123° 49,7' E. Foto P. Maestrati, MNHN.

Lithophaga hanleyana sensu Gohar & Soliman - Kleemann, 1977: figs 1a, 5-6.

Leiosolenus laevigatus (Q & G) - Wilson, 1985: pp. 184-186, figs 1A, 2-5, 6C, 7C.

Lithophaga laevigata (Q & G) - Kleemann, 1980a: pp. 25-32, fig. 1. Kleemann, 2008: fig. 1, bottom right, fig. 2D. Kleemann & Hoeksema, 2002: fig. 6. Kleemann, 2010: p. 502, pl. 942, fig. 2.

Types

Syntypes, MNHN, two broken specimens, glued together, labelled "Lithodomus laevigatus Quoy & Gaimard, 1829 (sic), Timor", 24.4-8.4-(3.6x2) mm and 18.9-7.0-6.2 mm (Kleemann 1980: fig. 1). Type locality, Timor (Kleemann 1980a: 25). Host coral, *Leptastrea purpurea* (Dana, 1846) (Kleemann 1980a: fig. 14; cf. Kleemann 1992: pl. 3, figs 1, 2).

Material examined

New Caledonia, Lagon, Nouméa, Stn 22, 22° 26' S 166° 23' E, 11 m, 23May84: 19.1-6.7-? mm. Stn 281, 22° 24' S 166° 24' E, 10 m, 09Nov84: >20 mm. Grand Récif Sud, Stn 551, 23° 00' S 166° 59' E, 9 m, 15Jul85: broken. Secteur des Belep, Stn 1089, 19° 47' S 163° 55' E, 35 m, 24Oct89: 11.6 mm. French Polynesia, Tuamotu Archipelago, Atoll de Mataiva, lagon (formations de Porites), 1986: ~1000 or more specimens, probably the largest measured 38.8-11.2-8.7 mm, being very slender, a few more 34.3-11.0-9.9, 34.2-12.3-9.4 (note the height), 33.7-

11.7-10.1, 32.4-11.8-8.5 mm. NC, NS, Stn 1373, 22° 19.7' S 166° 13.2' E, 9-10 m, 5May93: 11.1-4.3-3.9 mm. Lagon Ouest, Ilôt Maitre, 17.11.1989, 3 m, in *Stylophora mordax* (boring bivalves in the coral skeleton): >14, > 12, 12.1-5.0-4.2, 10.1-3.6-3.5, 9.2-3.6-3.2, ~ 9 mm. Lifou 2000, Stn 1419, 20° 55.6' S 167° 04.5' E, limon sur dalle, algues photophiles, 5 m, 10Nov: 22.5-7.3-5.9 mm. SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé, et la côte sable grossier sur dalle, 4 m, 26-27Nov: 15.0-6.0-4.9 mm. As before: 25.0-7.6-5.9, >18, 16.4-6.2-5.1 mm. Stn 1434, 20° 52.5' S 167° 08.1' E, devant l'îlot Huca Hutighé, fonds durs, 5-20 m, 06Nov: 18.2-6.0-4.7, 16.9-6.0-4.8, 14.5-5.3-4.4, 14.3-5.3-4.6, 14.2-5.1-4.2 mm. Stn 1446, 20° 50.8' S 167° 09.7' E, Est de la Baie du Santal, Mepinyo, bas du tombant, 36-40 m, 16Nov: 13.8-5.8-5.0, 10.5-4.6-3.8 mm. Stn 1450, 20° 45.8' S 167° 01.65' E, au Nord du Cap Aimé Martin, brossages, 27-31 m, 17/21Nov: ~10, 9.2-3.6-? mm. Stn 1451, 20° 47.3' S, 167° 06.8' E, Ouest de la Pointe d'Easo, 10-21 m, 2^{ème} patate corallienne, 19Nov: 10.7-4.3-3.5 mm. As before: 15 mm. As before: 11.7-5.0-4.1 mm. Stn 1459, face à la plage de Ngoni, dragages, 55-60 m, 20° 47.0' S, 167° 03.0' E, 5/13Nov: 16.6-5.8-4.4, 14.0-5.7-4.9, 12.7-5.4-4.6, 15.3, ~14, <12 mm. Stn 1460, 20° 52.4' S, 167° 08.0' E, Est de la baie, devant l'îlot Huca Hutighé, dragages, 40-60 m, 06Nov: 17.9-5.8-4.5, 17.3-6.4-5.3, 13.7-6.0-5.4, 13.5-5.8-5.1, 13.5, 13.2, 12.0-4.9-3.8, ~4.5 mm. Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sables et débris coralliens, 20-30 m, 10Nov: 13.7-5.5-4.1, 10.8-4.3-3.4 mm. Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 12.1-4.2-3.4 mm. As before: 10.8-4.5-3.6 mm. Stn 1466, 20° 46.5' S 167° 06.2' E, Baie de Huneté, dragages, blocs coralliens, 25-45 m, 17Nov: 16.8-6.0-5.2, rv 20.0-7.3-(3.2 x2) mm. PH, Panglao 2004, Catarman, Stn B7, 9° 35.9'N, 123° 51.8'E, reef slope with caves, 4-30 m, 05Jun: 20.1-6.5-5.3 mm. PI, Sungcolan Bay, Stn B14, 9° 38.5'N, 123° 49.2'E, 2-4 m, coral rubble, 16Jun04: >10, 8.4, 6.9, 5.8 mm. As before: 7.2, 5.1, ~4, 3.5. Bohol Island, Ubajan, Stn B20, 9° 41.5' N, 123° 51.0' E, 2-8 m, rocks and corals with sand and mud, 23Jun: 6.5 mm, plus 8 smaller specimens. As before, Stn R26, 9° 38.5' N, 123° 49.7' E, 1-5 m, blocks dispersed among seagrass, 20Jun: 11.2-4.1-3.5 mm (Fig. 5A-C). As before: 14.1-5.2-4.6, 9.4, ~9, 7.7, 7.1, ~3.5 mm. As before, Momo Beach, Stn R37, 28-32 m, caves in the reef wall, 9° 36.5' N, 123° 45.6' E, 10Jun: 8.5 mm, broken. Stn R53, 9° 38.5' N, 123° 49.7' E, 3-5 m, fringe mangrove, sand and seagrass, 20Jun04: from/in live, branching *Montipora*. Vanuatu, Santo 2006, Palikulo Bay, Stn FB43, 15° 28.4'S, 167° 14.9'E, 19 m, massive dead corals, 30Sep: >10 mm.

Diagnosis

Small, with posterior incrustation formed by fine divaricating ridges, protruding somewhat beyond the shell rim as minute interlocking teeth.

Description

Shell up to 40 mm long, smooth, periostracum yellowish

to light brown, covered latero-posteriorly by an incrustation of thin, slightly wavy, hard ridges, divaricating in a chevron pattern or resembling ripple marks (Fig. 5A-B), and increasing somewhat in width towards the end, protruding somewhat beyond the shell rim as interlocking teeth (Kleemann, 1977: figs 1a, 5-6, named *L. hanleyana* sensu Gohar & Soliman (1963a: fig. 8A, B). The narrow grooves between the ridges are filled with softer white deposits, levelling the surface and make it look smooth. For more details see Kleemann (1980a: pp. 25-32).

Remarks

Originally described in 1835, the name *laevigata* probably refers to the missing antero-ventral striae, found in *Lithophaga* s.s. species, which at that time were almost the only known representatives of the genus (Kleemann, 1983: p. 30). For a lengthier treatment of the species, including a more detailed synonymy and a bibliography until 1972, see Kleemann (1980a). This species has the widest range of host corals, although those named by Gohar & Soliman (1963a: p. 85) are usually inhabited by three different species (Kleemann, 1980a, 1992, 1995, 2008; Kleemann & Hoeksema, 2002; Wilson 1985; Morton 1990). Kleemann (1982) described a Badenian (Middle Miocene) record of *laevigata* in *Tarbellastraea* from the Vienna Basin.

Lithophaga (Leiosolenus) lessepsiana (Vaillant, 1865)

Lithodomus lessepsianus Vaillant, 1865: pp. 115, 123, 124.

Lithophaga cumingiana Dunker - sensu: Gohar & Soliman 1963a: pp. 73-82, pl. 1, fig. 1 left (only from *Stylophora*). Soliman, 1969: text-figs 1A, 2A.

Lithophaga (Leiosolenus) lessepsiana (Vaillant) - Arnaud & Thomassin, 1976: p. 367ff, figs 5-7 (in *Heteropsamnia*).

Lithophaga lessepsiana (Vaillant) - Kleemann, 1980a: p. 32-35 (with synonymy), figs 2 (2 syntypes), 25 (in *Heteropsamnia*). Mokady et al., 1991: pp. 205-216; 1993: pp. 245-252. Kleemann, 1995: tab. 1, pl. 1, fig. 3.

Leiosolenus lessepsiana (Vaillant) - Wilson 1985:pp. 186, 187, except from *Acropora palifera*.

Lithophaga (Leiosolenus) lessepsiana (Vaillant) - Kleemann & Hoeksema, 2002: p. 17, fig. 8.

Non *Leiosolenus lessepsianus* - Oliver, 1992: pp. 47, 55, 228, text-fig. 29a, b, pl. 7, fig. 8a, b = *laevigata* (Quoy & Gaimard, 1835).

Types

Syntypes, MNHN, specimens broken, one glued together, 20.5-7.0-6.3 mm, a right valve 14.5 mm in length (both figured in Kleemann 1980a: fig. 2), fragments of probably two other shells. Type locality, Suez, Red Sea. Host coral, *Stylophora pistillata* (Esper, 1797) (Vaillant, 1865: p. 124; Kleemann, 1980a: fig. 23).

Material examined

New Caledonia: Expédition Montrouzier, NCKS, Stn 1307, 20° 33.7' S 164° 10.3' E, Passe du Baron, 12 m, sand with *Heteropsamnia*, Oct93: 13, 11.3-4.7-4.4, > 11, 10.6-~4-

?, 9.9-3.9-4.1, 6.4 mm (two specimens still attached to coral fragments).

Diagnosis

Small, posterior incrustation weak (syntypes), fine-grained, smooth looking, periostracum fair to light-brown (not purplish).

Description

Shell subcylindrical, small, rarely >25 mm in length, smooth and fragile, umbos sub-terminal, dorsal angle usually inconspicuous, ventral line straight, periostracum yellow to light brown, posterior incrustation weak, fine-grained, may form vertical ridges, resembling a minute file, almost not protruding beyond the slightly attenuated shell rim. The species does not rotate, but may alter the direction of boring (Kleemann, 1994: fig. 3), which may help to avoid intra-specific space competition in crowded situations as illustrated in Loya & Klein (1998: p. 146).

Remarks

For a detailed treatment of the species, including more synonyms and a bibliography until 1978, see Kleemann (1980a). Inhabitant of mainly pocilloporid hosts (Kleemann, 1995: tab. 1) and *Heteropasmia* (Arnaud & Thomassin, 1976). The distinction between species associated with live coral can be difficult, but sometimes the host corals are good indicators for the membership of their bivalve dwellers to certain species (Kleemann, 2008). Further research on such associations may yield more evidence for splitting or combining "species" and shed more light on this type of co-evolution. It would be worth while to check whether specimens from *Heteropasmia* actually belong to *L. lessepsiana* and how this species differs from *L. simplex*. The latter was treated as a synonym of the former by Wilson (1979: pp. 450, 455). Wilson (1985) regarded *L. kuehnelti* Kleemann, 1977, *L. laevigata* and *L. simplex* as sibling species, the latter as probably conspecific with *L. lessepsiana*. Kleemann & Hoeksema (2002) recorded *lessepsiana* from fungiid hosts. Determining whether the named species are valid or not requires further investigation, with ultimate verification or falsification, probably provided by DNA analysis.

Lithophaga (Leiosolenus) lithura Pilsbry, 1905

Lithophaga lithura Pilsbry, 1905: p. 119, pl. 5, figs 37-39.

Lithodomus lithura Pilsbry - Kühnelt, 1930: pp. 74, 75, text-fig. 5.
Lithophaga (Doliolabis) lithura Pilsbry - Hirase & Taki, 1951: pl. 19, fig. 5.

Types

2 syntypes, ANSP88294, 37.2 (mere shell 32)-12.4-10.0 mm, 33.0 (32.3 lv)-10.2-9.0 mm. Type locality, Kikai-gashima, Osumi, Japan.

Material examined. French Polynesia, Austral Islands, Rapa 2002, Stn 34, 27° 34.8'S, 144° 19.0' W, Grotte au SE de la pointe Tematapu, 2-8 m, tombant dans un grande grotte, fond vaseux, 19Nov: 30.8-9.6-7.4, 29.9-9.8-8.5, 25.3-9.2-7.6, 23.5(rv)21.5-7.9-6.8, 19.6-6.8-5.5 mm. Stn 87, 27° 36.4'S, 144° 22.6'W, Baie Anarua, marée, Fond de baie et entrée de grottes, 25Nov: 39.7-12.6-0.8, 38.4~11-? mm.

Diagnosis

Shell posteriorly dark violet and squarely truncate, a thickening calcareous layer projects beyond the shell rim, abruptly narrowing into a median spur.

Description

Shell up to 40 mm long, sculptured only by growth-lines, subcylindrical with a hemispherical anterior and a sharply truncated, even slightly concave posterior end, usually extended several millimetres by a compacted, dense incrustation, with excavated inner faces, projecting tip-like or in median, pointed spur (Pilsbry 1905: pl. 5, fig. 38). Umbos subterminal, dorsal angle inconspicuous, hinge line long, ventral margin almost straight, periostracum purplish.

Remarks

For late references see Bernard et al. (1993) and Cai & Liu (2003). The present material shows, instead of the typical incrustation but a mixture of patterns. Nevertheless, the specimens appear closest to *lithura*.

Lithophaga (Leiosolenus) malaccana (Reeve, 1857) (Fig. 6A-C)

Lithodomus malaccanus Reeve, 1857: sp. 20, non pl. 4, fig. 20. Kleemann, 1984: fig. 10 (holotype)

Lithophaga reticulata Dunker, 1880-83: pp. 19, 30, 32, pl. 5, figs 9, 10. Kleemann, 1983: p. 21.

Lithophaga malaccana Dunker, 1880-83: pp. 20, 30-32, non pl. 5, fig. 1 (from Reeve 1857: pl. 4, fig. 20).

Dactylus fauroti Jousseaume, 1888: pp. 217, 218. Kleemann 1983: p. 10. Kleemann, 1984: fig. 11 (holotype).

Lithophaga hanleyana Lamy (non Reeve), 1919: pp. 344, 345.

Lithophaga (Diberus) malaccana (part) Lamy, 1937: pp. 124, 125, 127, 128.

Lithopluga calcifer (part) Iredale, 1939: pp. 430-431, pl. 6, fig. 28. Wilson, 1979: p. 488, fig. 18/5a-c (holotype) = *malaccana* (error for *malaccana*).

Leiosolenus (Diberus) malaccanus (Reeve) - Huber, 2010: p. 120, middle figure in 3rd row.

Lithophaga (Leiosolenus) malaccana (Reeve) - Kleemann, 2010: p. 504, pl. 943, figs 1a, b, 2.

For more synonymy see Kleemann (1984: pp. 199, 201).

Types

Holotype, NHMUK 1975104, 28.6 rv(26.6 lv)-8.4-7.4 mm (Kleemann 1984: p. 199, fig. 10). Type locality, Malacca. The type of *L. reticulata* could not be located (Kleemann

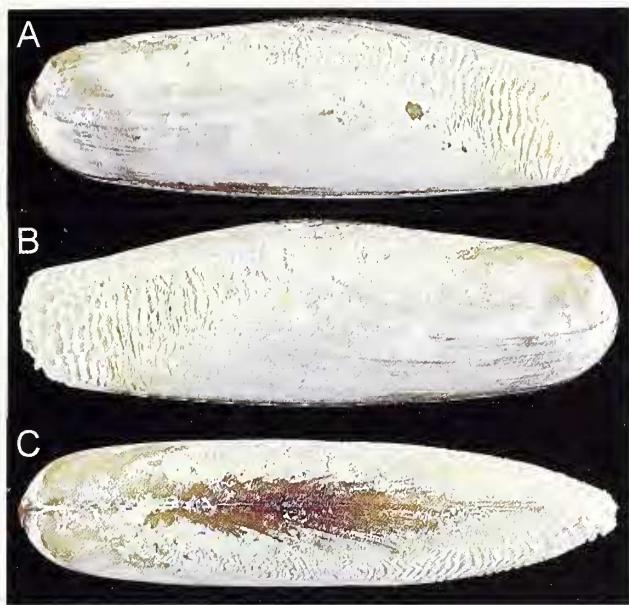


Fig. 6. *Lithophaga (Leiosolenus) malaccana* (Reeve, 1857), 24.9-8.0-6.1 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, incrustation reticulated only at the far end, otherwise rather atypical, resembling ripple marks, 4 m, fine sand and algae on flat rocks, Loyalty Islands, Lifu, Bay of Gaatcha, near Cap Mandé, 20° 54.9' S 167° 03.0' E, Stn 1424, 15Nov2000. Images by P. Maestrati, MNHN.

Fig. 6. *Lithophaga (Leiosolenus) malaccana* (Reeve, 1857), 24.9-8.0-6.1 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, incrostante reticolata solo verso l'estremità, per il resto piuttosto atipica, a forma di *ripple marks*, 4 m, fine sabbia e alghe su rocce piatte, Isole Loyalty, Lifu, Baia di Gaatcha, vicino al Capo Mandé, 20° 54.9' S 167° 03.0' E, Stazione 1424, 15 Novembre 2000. Foto P. Maestrati, MNHN.

1984: p. 201). Type locality, Java? Holotype of *D. fauroti*, MNHN, 32.7-11.0-10.0 mm (Kleemann, 1984: fig. 11). Type locality, Obock, Red Sea. Holotype of *L. calcifer*, AM C60402, 42-13-11 mm (Kleemann, 1984: fig. 12). Type locality, Low Isles, Queensland.

Material examined

Ethanol:

New Caledonia: Musorstom 5, Banc Capel, St. 264, 25° 20' S 159° 44' E, 56 m, 08Oct86: 8 mm. Expédition Montrouzier, NCTS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut-Fond de la Tié, 5-25 m, tombants, sable sur dalle, Sep93: 22.9-6.5-?, 15.6-5.3-5.2 mm. Lagon, Stn 99, 22° 33 S, 166° 35' E, Ile Ouen, Baie du Prony, 14 m, 21Aug84: 14.5, 10.6 mm. Stn 1356, 22° 19.75' S 166° 15.40' E, Lagon de Nouméa, canyon de la Dumbéa, 20-23 m, tombant, passées sableuses, 04Dec92: 13.4-4.5-3.9, 12.0-4.0-3.7, 7-2.7-2.1 mm. Lifou 2000, GB, Stn 1419, 20° 55.6' S 167° 04.5' E, limon sur dalle, algues photophiles, 5 m, 10Nov: 20.7-6.3-? mm. As before: 16.5-5.1-4.2, 16.0-5.6-4.9 mm. SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé, et la côte, sable grossier sur dalle, 4 m, 26-27Nov: 16.0-6.5-5.2 mm. Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1429, 20° 47.5' S 167° 07.1' E, patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 18.0-5.5-4.5, 15.7-4.9-4.0, 14.8-4.9-4.2, 11.7-4.3-3.8 mm. As before, Stn 1431, 20° 47.5' S 167° 07.1' E, récoltes à vue, 18-35 m, 3/5/7/9/17/23-24Nov: 18.9-5.1-4.5 mm. Entre l'îlot Huca Hutighé, Stn 1434, 20° 52.5' S 167° 08.1' E, fonds

durs, 5-20 m, 06Nov: 24.5-7.9-7.1 mm. As before: *L. (Leiosolenus) ? malaccana* (Reeve, 1857), 23.0-7.3-6.4 mm. GB, Stn 1436, patate corallienne sur tombant, 10-20 m, 20° 55.5' S 167° 04.2' E, 10Nov: 21.6-7.2-6.2, 19.5-6.8-5.7, 19.1-6.0-5.2, 17.9-6.3-5.4, 17.3-5.6-4.8 mm. Ouest de la Pointe d'Easo, Stn 1451, 20° 47.3' S, 167° 06.8' E, 10-21 m, 2^{ème} patate corallienne, 19Nov: 22.5, 20.7-6.7-6.0, 20.4-7.2-5.9, >20, 20, 19.9-6.5-?, 17.9-6.8-6.0, ~17.8-5.9-5.2, 16.6-5.4-5.1, 15.9-5.7-?, 15.6-5.4-4.6, 15.5-5.0-4.1, >13mm. Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: ~15.5, 14.0-5.0-?, ~13, >11 mm. Stn 1459, 20° 47.0' S, 167° 03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 21.5-7.2-6.2, 21.3, 22.4-7.6-6.8, 19.3-6.8-5.7, ~19, 17.8-6.7-6, 17.7-6.0-5.5, 17.6-6.6-5.5, 16-7.6.2-4.7, 16-7-5.9-5.8, 16.0-9.7-4.8, 13.5-4.7-3.7, ~13.5, 11.9-4.3-3.7, 12.6-4.7-3.8, 10.9-5.2-3.5 mm. GB, Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sables et débris coralliens, 20-30 m, 10Nov: 24.7-7.0-6.5, 24.1-8.0-6.8 mm. Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 22.7-6.7-5.4, 22.6-7.5-6.6, 20.5-6.8-6.0, 18.2-6.7-5.7, 18.4-5.5-4.8, 17.0-5.8-4.9, 16.9-5.6-4.7, 16.4-5.1-4.1, 15.4-5.5-4.6, 15.5-5.2-4.4, 15.3-5.2-4.5, 14.3-5.0-4.3, 15.0-5.1-4.3, 14.5-4.9-4.1, 13.2-4.3-3.7, 13.2-4.2-3.7, ~13mm.

Dry Material:

New Caledonia, Lagon, 1984, NS, Stn 21, 22° 23' S 166° 23' E, 10 m, 23May: 11.6-4.3-? mm. Stn 22, 22° 26' S 166° 23' E, 11 m, 23May: 13.9-5.1-?, 13.0-5.4-? mm. Stn 28, 22° 15' S 166° 33' E, 9 m, 23May: 17.8-5.4-5.1 mm. NC, Stn 82, 22° 33 S, 166° 29' E, Ile Ouen, Baie du Prony, 10 m, 21Aug: rv 21.0(18.8)-6.6-?, 21.0-6.6~6, 18.4-5.7-? mm. NC, Stn 160, 22° 36 S, 166° 37' E, Ile Ouen, Baie du Prony, 10 m, 24Aug: >20, >13.5, 11.5 mm. NC, Stn 192, 22° 01' S 166° 60' E, Baie de St Vincent, 18 m, 19Sep: 17.6-5.5-4.6 mm (resembling *plumula*). As before: 17.6-5.5-4.6 mm (resembling *plumula*). NS, Stn 277, 22° 17' S 166° 16' E, 30 m, 08Nov: 10.3-3.5-3.0, 9.7-3.4-3.2, 9.7 mm. NS, Stn 268, 22° 20' S 166° 17' E, 24 m, 08Nov: 14.8-5.5-5.2 mm. NS, Stn 290 ?, 22° 16' S 166° 32' E, 11 m, 09Nov: 12.9 mm. Grand Récif Sud, Stn 312, 22° 42' S 166° 49' E, 26 m, 27Nov: 15.8 mm. 1985, Stn 589, 22° 32' S 167° 24' E, Ile des Pins, 31 m, 18Jul85: 14.2 (~12)-7.8- 5.0 mm. 1987, Secteur de Pouébo, Stn 877, 20° 33' S 164° 50' E, 40 m, 13Jan: 16.7-5.4-? mm. Secteur de Pouébo, Stn 886, 20° 24' S 164° 41' E, 20 m, 14Jan87: 12.3 mm. 1988, KS, Stn 912, 20° 57' S 164° 33' E, 8-12 m, 26Apr88: 15.1(12.8 shell only)-4.5-? mm. Secteur de Poum, Stn 962, 25-26 m, 20° 27' S 164° 01' E, 28Apr88: 12.1 (10.8)-4.0-3.6 mm. KS, Stn 948, 20° 32' S 164° 09' E, 16 m, 28Apr: 26.3~8-?, 19.3-7.6-? mm. Secteur de Poum, Stn 1006, 20° 13' S 163° 55' E, 18-25 m, 02May: 12.3-4.3-?, >12 mm. 1989, BS, Stn 1072, 19° 56' S 164° 02' E, 20 m, 23Oct: (r v)14.7-5.2-(2.2 x2) mm. BS, Stn 1088, 19° 46' S 163° 58' E, 23 m, 24Oct: 13.3-4.5-3.9 mm. Stn 1118, 19° 35' S 163° 52' E, 30 m, 25Oct: 10.4-3.6-3.1 mm. Stn 1128, 19° 31' S 163° 52' E, 26 m, 26Oct: >>18.5, >>8.5 mm. Stn 1180, 19° 24' S 163° 18' E, 53 m, 31Oct: 22.6, 14.1, 13.9-4.1-3.6, mm. 1992, NS, Récif Senez, Stn 1343, 22° 17.8' S 166° 19.9' E, 7 m, pente interne, 07Sep:

13.6-4.2-3.8, 11.4-3.7-3.3 mm. NS, Pointe Magnin, Stn 1355, 22° 18.9' S 166° 26.6' E, 7-10 m, bord du canyon, blocs, sédiment, 03Dec: 6.6-2.6-2.7, 5.6-2.0-1.9 mm. Expédition Montrouzier, TS, Banc de Touho, Stn 1240, 20° 46.5' S 165° 14-15' E, 0-2 m, platier abrité: 14.7-4.9-4.0 (predation hole in lv), 14.6 mm. TS, Banc de Touho, Stn 1259, 20° 46.6' S 165° 13.7' E, 15-35 m, tombants avec limon: 24.5-7.1-?, 16.2-4.5-?, 15.9-4.8-(2.1 x2) mm. TS, Lagon du Grand Récif Mengalia, Stn 1264, 20° 44.5' S 165° 15.9' E, 8 m, vase sableuse, dôme détritique: 10.2-3.3-? mm. As before, Stn 1266, 20° 39.6' S 165° 14.7' E, 10-15 m, pâré corallien: (lv)27.6 (rv)26.7-8.1-6.9, 15.3-4.7-?, lv 15.2-5.4-(2.3 x2), 6.6-2.2-? mm. TS, Récif Doiman, Stn 1269, 20° 35.15' S 165° 08.1' E, 15-20 m, pente externe: rv 10.9-4.2-(1.9 x2), 4.0-1.8-1.7 mm. TS, Stn 1270, 20° 45' S 165° 16.5' E, Grand Récif Mengalia, 10-35 m, gente externe: 16.1-5.0-?, 4.9 mm. TS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut-Fond de Tié, 5-25 m, tombants, sable sur dalle: 23.6-6.5-5.7, 21.1-6.5-6.0, 18.7-6.6-5.7, 18.1-5.5-4.7, 16.7-6.1-5.3, >20, 15.9-5.7-?, >16, 13.5-5.1-4.4, 14.4-5.0-4.1, 13.4-4.8-4.1, 13.7-5.0-4.3, 13.0-4.5-3.6, 10.4-3.7-3.3, 11.5-4.1-3.3, 11.5-4.1-3.3, 11.0-4.0-3.4, 11.5-4.4-3.8, 12.1-4.0-(1.7 x2), 11.0-4.3-4.0, 10.6-3.5-2.9, 6.9, 6.4, 6.2-2.3-?, rv 5.2 mm (predation hole ~0.2 mm). TS, Ilot de Sable, Passe de Touho, Stn 1272, 20° 49.5' S 165° 19.6' E, 10 m, fonds durs avec limon: 21.4-7.1-6.0, 20.0-6.4-5.2 mm. TS, récif extérieur, Passe de Touho, Stn 1273, 20° 50.4' S 165° 22.8' E, 20 m, fonds durs, taches de sable: 15.6-4.7-? mm. Oct93: KS, Pointe de Babouillat, Stn 1291, 20° 22.4' S 164° 06.8' E, marée, rochers littoraux: 17.1-5.8-5.1, 13.8-4.9-4.3, >13, ~3 mm. KS, Lagon, parages du Plateau Karembe, Stn 1303, 20° 37.7-38.8' S 164° 15.9-17.1' E, 0-8 m, sable vaseux, blocs: 17.3-5.3-4.5, 15.7-5.5-? mm. KS, Récif de l'Infernet, Stn 1302, 20° 35.8' S 164° 12.7' E, 9-10 m, pente interne: 14.0-4.4-4.0, 11.9-4.2-3.9, 8.8-3.5-3.1 mm. As before: 11.6, 11.2-4.2-3.5, 11.5, 9.0-3.3-3.2, 9.0-3.2-?, 7.5 mm. KS, Chenal de l'Infernet, Stn 1305, 20° 36.2' S 164° 11.0' E, 12-15 m, sable gris: 15.7-5.5-4.5, 8.6 mm. KS, Passe de Koumac, Stn 1311, 20° 40.4' S 164° 14.9' E, 10-60 m, fonds durs: 5.6 mm. KS, Grand Récif de Koumac, Stn 1316, 20° 40' S 164° 11.2' E, 12 m, pente externe: >17 mm. As before, Stn 1318, 20° 41.4' S 164° 14.8' E, 20-30 m, pente externe: 12.2-4.6-4.3 mm. As before: 14.2-4.3-3.4, rv 12.0-4.1-(1.5 x2), 9.8-3.4-?, 9.6-3.5-3.2, 7.5-2.5-2.3, 7.2-2.3-2.1 mm. 1993, NS, îlot Goéland, Stn 1368, 22° 24.3' S 166° 20.7' E, 10 m, fonds blancs, 16Apr: 16.5 mm. As before: 13.1 mm. Campagne Plouveal 1999, Stn CP1380, 18° 26.9' S 163° 12.7' E, 24-29 m, 3May: rv 22.9(20.5)-7.5-(3.3 x2), lv 25.5(21.8)-7.5-(3.4 x2) mm. Stn CP1386, 18° 35.0' S 163° 96.0° 06.0' E, 45 m, 10May: 14.3-4.8-4.5 mm. Stn CP1388, 18° 23.8' S 163° 06.9' E, 40 m, 11May: 24.5-7.8-6.3 mm. Campagne Paleo-Surprise, Stn DW1395, 34-36 m, 18° 17.6' S 163° 01.9' E, 13May99: 13.9-4.9-?, 11.6-4.0-3.4 mm. Lifou 2000: SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé, et la côte, sable grossier sur dalle, 4 m, 26-27Nov: 25.3-8.0-6.9, 23.7-8.3-7.0, 20.1-7.1-6.5, 20.1-6.6-5.7, 18.5-6.6-5.6, 20.2-6.1-5.4, 18.6-6.5-5.4, 18.1-6.2-5.0, 18.0-6.0-5.2, 17.9-6.2-5.3, 17.2-5.6-4.7, 16.5-5.3-4.5, 16.2-5.2-4.4, 15.7-5.0-4.1, 15.6-5.5-5.0, 15.5-5.3-4.9, 15.4-5.7-4.9, 15.4-5.0-4.2, 15.1-5.0-4.1, 14.9-5.7-4.8, 14.1-5.1-4.1, 14.0-

5.0-3.9, 13.0-4.7-4.0, 13.3-4.1-3.3, 13.2-4.9-4.3, 11.6-4.0-3.6, 10.3-3.4-2.8, rv 20.0-6.5-(2.9 x2), rv 22.9-7.3-(3.1 x2), 6.8-2.9-2.4, 6.4-2.3-? mm, + 5 broken specimens. GB, vers le Cap Mandé, Stn 1424, 20° 54.9' S 167° 03.0' E, sable fin et algues photophiles sur dalle, 4 m, 15Nov: 24.9-8.0-6.1 mm (Fig. 6A-C). SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1429, 20° 47.5' S 167° 07.1' E, patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 19.9-6.4-5.4, ~15, 15.1-5.0-4.2, 12.0-4.3-3.7, 12.6-4.3-3.7, 12.6-4.3-3.7, 12.7-4.2-3.7 mm. SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1431, 20° 47.5' S 167° 07.1' E, récoltes à vue, 18-35 m, 3/5/7/9/17/23-24Nov: 24.4-9.0-8.1, 21.7-6.5-5.2, 20.8-6.7-5.8, 20.0-6.5-5.6, 18.2-5.9-5.3, 17.7-5.6-?, 15.3-5.1-4.4 mm. SB, Stn 1434, 20° 52.5' S 167° 08.1' E, devant l'îlot Huca Hutighé, fonds durs, 5-20 m, 06Nov: lv 23.5, 22.8-7.0-5.7, 22.4-6.8-5.3, 20.4-7.3-6.1, 15.2-5.9-4.8 mm. SB, Stn 1435, 20° 55.2' S 167° 00.7' E, Pointe Lefèvre, tombants verticaux et surplombs, 5-30 m, 08Nov: 16.8-5.3-4.6 mm. SB, GB, Stn 1436, 20° 55.5' S 167° 04.2' E, patate corallienne sur tombant, 10-20 m, 10Nov: 2 specimens enclosed near live part of *Porites*, the hole of a third specimen partly surrounded by live *Pavona varians*? SB, Stn 1450, 20° 45.8' S 167° 01.65' E, au Nord du Cap Aimé Martin, brossages, 27-31 m, 17/21Nov: 23.3-7.6-6.3, 14.6-5.4-4.3, ~5.5 mm. SB, Ouest de la Pointe d'Easo, Stn 1451, 2^{ème} patate corallienne, 10-21 m, 20° 47.3' S 167° 06.8' E, 19Nov: 23.0-7.7-6.9, 23.4-7.2-5.6, 21.6-7.4-6.5, 19.7-6.8-6.3, 21.2, 20.8-7.0-6.2, 20.9-6.9-5.6, ~19, 18.0-5.9-4.6, 20.2-6.7-5.6, 20.5-6.6-6.0, 18.9-6.1-5.1, 16.8-5.7-4.9, 18.3-6.3-4.8, ~18.5, 15.3-6.5-~, 1.3-4.2-3.5, ~11 mm. SB, Stn 1457, 20° 46.8' S 167° 02.75' E, devant Ngoni, surplomb sciaphile et blocs, 5-10 m, 27Nov: 13.3-4.3-3.3, 12.3-4.0-3.4, 10.7-3.5-3.1 mm. SB, Stn 1426, 20° 45.9' S 167° 06.2' E, devant Hunetë, dalle et petites poches de sédiment, 4-7 m, 20Nov: 18.11-6.0-5.4 mm. SB, Stn 1458, 20° 46.7' S 167° 03.1' E, en face de la plage de Ngoni, dragages, 17-24 m, 4Nov: 17.3-5.2-4.6 mm. SB, Stn 1460, 20° 52.4' S, 167° 08.0' E, Est de la baie, devant l'îlot Huca Hutighé, dragages, 40-60 m, 06Nov: lv 24, 23.1-7.5-6.1, 22.3-7.0-5.8, rv 22.1, lv 22, lv 19.8, >19, lv 17.3, 16.7-6.4-5.3, 14.7-4.7-3.9, 13.6-4.8-4.2, 13, 9.7-3.5-3.0, 11.7 mm, and some more. SB, Stn 1462, 20° 47.1' S 167° 93.2' E, Arrête au SE de la Pointe Aimé Martin, dragages, 50-120 m, 9/21Nov: ~11.4-3.3.5 mm. SB, Stn 1465, 20° 47.7' S 167° 07.0' E, de part et d'autre de la Pointe d'Easo, dragages, blocs et coraux, 35-44 m, 16Nov: 21.1-7.0-5.8, 18.3-6.8-6.0, ~15-5.5-4.1, 13.4-5.2-4.5, 12.8-5.3-4.4, 12.3-4.2-3.6, 8.6-3.1-2.8 mm. SB, Stn 1466, 20° 46.5' S 167° 06.2' E, Baie de Hunetë, dragages, blocs coralliens, 25-45 m, 17Nov: 22.2-6.6-5.3, 19.8-6.7-5.7, 17.0-6.1-5.5, 14.5-4.5-3.9 mm. SB, Stn 1459, 20° 47.0' S, 167° 03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 17.3-6.1-4.7, 15.5-5.9-5.1, 15.8, 15.7-5.7-4.9, 15.4, 14.5, 13.0-5.3-4.0, 12.0-4.4-3.7, 11.5, 11.3-4.2-3.6, 12.3-4.8-3.9, ~11, >12, 10.7-4.2-3.4, 9.9-3.5-3.0, 9.5-3.7-3.2, 9.7-4.0-3.3, 7.5 mm, dead: 14.4-5.8-4.7, 14.4-5.5-4.6, lv ~13 mm. PH, Panglao 2004, Balicasag Island, Stn B41, 9° 30.9'N, 123° 40.8' E, 17-19 m, floor of large cave, 04Jul04: ~20.5, 17.1-5.8-5.3, 16.3-5.8-5.1, 16.3, 15.2 mm.

L. (*Leiosolenus*) *malaccana*? (Reeve, 1857), 19.0-6.7-5.6,

20.5-7.0-5.8, 22.0-7.9-6.8, 23.2-7.6-6.4, 22.9-7.6-6.1, 18.0-5.5-5.5, 19.9-6.5-5.5, 17.3-6.0-5.0, 20.8-6.9-5.5, 18.3-6.8-5.7, ~19.5, 20.3-7.6-6.5, 17.7-6.3-5.5, 16.0-5.7-4.8, 16.9-6.5-5.7, 22.5-7.3-6.4, 20.4-6.8-5.2, 19.5-6.4-5.6, 16.5-6.5-5.3, 19.4-7.6-6.4, 17.9-6.3-5.1, 14.1-5.5-4.9, 16.8-6.1-5.8, 18.0-6.1-5.1, 18.3-6.5-5.6, 18.1-6.4-5.5, 18.0-6.7-6.0, 20.5-7.0-5.8, 19.5-7.3-6.1, ~20, 19.1-6.8-5.4, 15.7-6.1-4.8, 17.5-6.3-5.5, 17.8-6.2-4.6, 18.6-6.7-5.9, 15.0-6.0-5.2, 16.6-6.0-5.0, 16.1-6.0-4.7, 16.7, 19.2-6.3-5.3, 17.5-6.0-5.1, 16.6-5.8-5.0, 20.4-6.6-5.7, 15.5-6.1-5.2, 17.3-6.3-5.5, 14.6-5.2-4.1, 16.8-6.2-5.4, 16.2-5.7-4.9, 15.9-5.7-5.0, ~14, 14.0-5.5-4.5, 14.4-5.0-4.2, 15.7-5.7-4.8, 17.1-5.5-?, 16.6-5.8-4.8, ~17, 14.2-5.0-4.6, 17.9-6.4-5.1, 15.9-6.0-5.2, 14.1-5.2-4.7, 13.8-5.4-4.7, 14.6-5.0-4.1, 13.8-5.2-4.2, 13.3-5.0-4.4, 12.2-4.6-3.9, 12.6-5.0-4.4, 12.5-4.4-3.9, 18.2-6.5-5.5, 13.9-4.8-4.2, 14.7-5.4-4.5, 12.6-4.9-4.0, 16.1-5.3-4.4, 11.6-4.9-4.1, 14.1-5.0-4.0, 11.5-3.7-3.3, 11.5-4.4-3.7, 13.8-5.6-4.4, 13.7-4.5-?, ~19, >16, 16.0-5.6-4.5; 11.9-4.2-3.8, 13.2-4.8-?, 10.3-3.4-3.1, ~14.5, 8.6-3.3-2.9, 9.8-3.6-3.0, 8.7-3.2-2.7, 13.0-5.0-4.1, 11.3-4.0-3.4, 12.6-5.4-?, 11.2-4.0-3.5, 12.1-4.3-3.8, 10.2-3.7-3.1, 10.2-4.0-3.4, 9.1-3.0-2.8, 8.1-3.2-2.7, 8.2-3.2-2.7, 8.2-3.2-2.6, 8.2-2.9-2.3, 7.1-2.7-2.4, 7.3-3.1-2.5, 7.6-2.8-2.2, >13, ~17, 13.7-5.2-?, 12.0-4.8-4.2; ~4.5 mm; dead: rv 23.5-8.0-(3.7x2), rv 21.0-7.5-(3.2x2), rv 20.8-6.5-(2.8x2), lv 19.9-7.8-(3.0x2), rv 19.5-7.1-(3.0x2), rv 19.0, lv 19.4-7.0-(2.9x2), rv 20.0-6.8-?, lv 20.0, lv ~18, rv 18.8-6.3-(2.8x2), lv 18.9-6.6-(2.7x2), lv 17.0-6.0-(2.8x2), lv 16.7-5.7-(2.5x2), lv 15.0-5.1-(2.3x2), lv 15.0-5.4-(2.1x2), rv 15.5-5.4-(2.1x2), rv 14.5-5.2-(2.4x2), rv 13.6-4.7-(2.1x2), lv 11.4-4.7-(1.8x2), lv 13.3-4.5-(2.0x2), rv 12.9-4.5-(1.9x2), rv 13.1-4.9-(2.1x2), lv 13.8, rv 11.6-3.8-(1.7x2), lv 10.4-4.0-(1.6x2), 8.2-3.3-3.0, rv >9 mm.
Reunion Island, MD 32 1982, Stn CP97, 19° 41' S 54° 09' E, 55 m: 24.3(23.7)-8.2-6.7 mm (lv + predation hole, ~ 1 mm). Coral 2, Stn DW84, 16-26 m, 19° 12' S 158° 57' E, 25Jul1988: 17.2 mm. Lifou 2000, SB, Stn 1415, devant Chépénéh sable, 3-7 m, 20° 47.1' S 167° 09.1' E, 25Nov: 15.2-5.2-4.5 mm. SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1431, 20° 47.5' S 167° 07.1' E, récoltes à vue, 18-35 m, 03/05/07/09/17/23-24Nov: >22 mm. BG, Stn 1436, patate corallienne sur tombant, 10-20 m, 20° 55.5' S 167° 04.2' E, 10Nov: 20.5-7.1-6.0, ~19.5, 18.3-6.1-5.3, 16.0-5.6-5.3, 16.0-5.64.6, 15.9-5.7-4.6, 14.2-4.7-3.9, 12.2-4.2-3.7, 12.3-4.0-3.5, 11.6-4.3-3.9, 10.8-3.8-3.2, 11.3-3.6-2.9, 9.9-3.3-2.9 mm, right valves: ~30-9.6-(3.6 x2), 25.3-8.1-(3.6 x2), 23.9-8.0-(3.2 x2), 19.5-6.5-? mm, left valve: 14.7-5.4-(2.1 x2) mm. Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1451, 20° 47.3' S 167° 06.8' E, 2^{ème} patate corallienne, 10-21 m, 19Nov: 10.7-3.8-3.2 mm. As before: lv 19.4-6.3-(2.6 x2) mm. SB, Stn 1446, 20° 50.8' S 167° 09.7' E, Est de la Baie du Santal, Mepinyo, bas du tombant, 36-40 m, 16Nov: 20.7-6.3-5.1, 16.0-4.8-4.0, 15.2-4.9-4.2, 11.6-4.0-3.2 mm. SB, Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: 20.9-6.5-5.2, 16.7-6.2-5.2, 15.9-5.0-3.9 mm, 13.2-4.9-3.9, 13.2, 13.5-4.5-3.8, 13.3-4.6-3.9, 12.1-4.0-3.2, ~12, 11.5-4.7-4.3, 10.7-4.2-3.5, >11, 9.8-3.9-3.3, 9.5-3.6-3.0, 9.5-3.3-2.7, ~5.5 mm. SB, NE de la Baie au niveau de Cila, Stn 1456, 20° 49.3' S 167° 10.4' E, tombant, 25-30 m, 26Nov: 18.9-6.3-5.0, 15.8-5.5-4.7, > 17 mm. SB, Est de la baie, Stn 1460, 20° 52.4' S, 167° 08.0' E, devant l'îlot Huca Hutighé, dra-

gates, 40-60 m, 06Nov: 23.4-7.6-6.0, 22.5-7.1-6.0, 21.9-6.6-5-0 mm. SB, Stn 1463, BG, dragages, sables et débris coralliens, 20-30 m, 20° 55.05' S 167° 03.35' E, 10Nov: 23.8-8.3-7.6, 19.1-7.1-6.2, 18.9-6.7-5.9, 18.8-6.3-5.1, ~18, 16.1-5.9-4.3, 13.8-5.6-4.8, 15.5-5.0-4.2, 14.8-5.0-4.0, 13.6-4.7-3.7, 14.8-5.1-4.2, 12.6-4.6-3.6, 12.2-4.0-3.2, 12.4-4.1-3.7, 12.3-4.5-3.8, 11.4-4.1-3.5, rv 21.2-7.0-(3.0 x2), lv 21.0-7.0-(3.0 x2), rv 17.8-6.7-(2.9 x2), rv 16.4-5.5-(2.1 x2), lv 13.7-5.0-(2.0 x2) mm. SB, Stn 1464, devant Peng, dragages, 20° 54.5' S 165° 05.9' E, blocs d'algues calcaires, 35-50 m, 14Nov: 33.4-9.3-7.6 mm. As before: 16.6-5.5-4.6, 14.3-5.5-4.1, 13.9-4.8-4.1, 13.7-4.5-3.8, 13.4-5.0-4.0, 12.8-4.5-3.9, 12.3, 10.5, 10.3, 9.7-3.2-? mm. SB, Stn 1467, 20° 46.6' S 167° 05.4' E, devant Hunetë, dragages, 90 m, 20Nov: 11.8-3.9-3.3 mm. PH, Panglao 2004, BAI, Stn L42, 80-90 m, 9° 31.2' N, 123° 40.7' E, 02Jul04: *L. cf. malaccana*, 13.0 mm, incrustation honeycombed (Fig. 7). Vanuatu, Santo 2006, SE Matewulu, Stn DB75, 15° 22.9'S, 167° 11.9'E, 20 m, 28Sep: 16.8-5.3-4.6 mm.

Fossil *Lithophaga malaccana* ?, 18.3-8.2-5.7 mm, Meilhan-Campagne (Landes), Carrière de St-Martin d'Oney, niveau à Madréporaires, Miocène inférieur (Burdigalien ?), coll. Dolin, Lozouet & Maestrati. A small part of the posterior shell incrustation remained attached to the right valve, resembling the pattern of *malaccana*.

Diagnosis

Shell usually less 30 mm long, posterior incrustation reticulated by diagonally crossing ridges, basically fused, protruding far beyond the shell.

Description

Small to middle-sized *Leiosolenus*, together with posterior prolongations rarely over 40 mm. Shell almost completely covered by calcareous deposits, thin and smooth antero-ventrally as in other species of the subgenus, but from the umbos, between the sulci to the posterior shell rim and distinctly beyond, a reticulated pattern is developed, increasing in thickness and mesh-width. Dead coral borer. For further details see Kleemann (1984: pp. 201, 203, figs 10-13, 15).



Fig. 7. Left lateral view of *Lithophaga (Leiosolenus) cf. malaccana*, 13.0 mm, incrustation honeycombed, 80-90 m, PHBAI, Stn L42, 9° 31.2' N, 123° 40.7' E, 02Jul04. Image by P. Maestrati, MNHN.

Fig. 7. Vista laterale sinistra di *Lithophaga (Leiosolenus) cf. malaccana*, 13,0 mm, incrostazione a favo d'api, 80-90 m, PHBAI, Stazione L42, 9° 31,2'N, 123° 40,7'E, 2 Luglio 2004. Foto P. Maestrati, MNHN.

Remarks

The figure of sp. 20, *L. malaccanus*, in Reeve (1857), depicts a young *L. plumula* (Hanley, 1843). Further confusion, mirrored in the synonymy (Kleemann 1984: pp. 199, 201), results from three syntypes (?) of *L. hanleyana* (Reeve, 1857), each belonging to a different species, including *L. malaccana* (see *hanleyana* above and remarks in Kleemann 1984: p. 203). Another problem in determining specimens is the obviously regional differences in meshsize and construction of the reticulated pattern (Fig. 6A, B). That pattern can sometimes be hidden under paste-like deposits or altered to a pattern of mainly vertical, connected elements, resulting in a more file-like surface than in many of the ? *malaccana* specimens listed below. Recorded depth range to 56 m.

Lithophaga (Leiosolenus) mucronata (Philippi, 1846) (Figs 8A-C, 9)

Modiola mucronata Philippi, 1846: p. 4/150, pl. 1, fig. 8.

? *Lithophagus calyculatus* Carpenter, 1856: pp. 124, 125 (Kleemann, 1983: p. 4).

Lithophaga mucronata Philippi - Dunker, 1883: p. 17. Non Poppe in Kleemann, 2010: p. 502, pl. 942, fig. 3 (= *L. simplex* Iredale, 1939).

Non *L. (Diberus) mucronata* Philippi - Boshoff, 1965: pp. 118, 119; Kilburn, 1977: p. 206 (= *malaccana*).

Non *Lithophaga mucronata* - Morton & Scott, 1980: pl. 1, fig. h. *Lithophaga mucronata* Philippi - Kleemann & Hoeksema, 2002: p. 19, fig. 11.

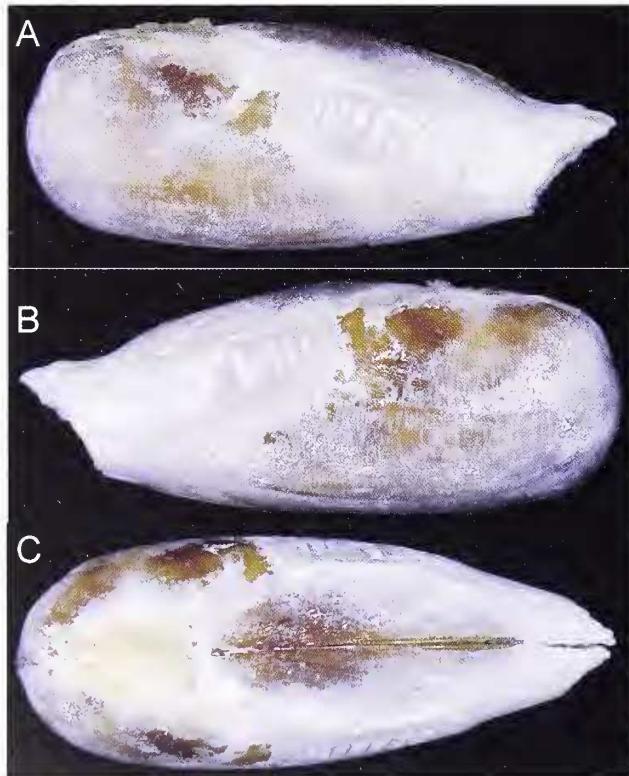


Fig. 8. *Lithophaga (Leiosolenus) mucronata*, 9.0 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 8 m, base of reef slope, Arco Point, Panglao Island, Philippines, 9° 33.5'N, 123° 48.6'E, Stn B3, 31May04. Images by P. Maestrati, MNHN.

Fig. 8. *Lithophaga (Leiosolenus) mucronata*, 9.0 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 8 m, base della scarpata di scogliera, Arco Point, Panglao Island, Filippine, 9° 33,5'N, 123° 48,6'E, Stazione B3, 31 Maggio 2004. Foto P. Maestrati, MNHN.

Leiosolenus (Labis) mucronatus (Philippi) - Huber, 2010: p. 121, left figure in 1st row.

Types

The type of *Modiola mucronata*, 10.9-4.3-4.3 mm, is probably at MHNNS, Chile. Type locality, Java. NHMUK Mazarlan Coll. 571, holotype of *calyculatus*, 9.1-3.8-4.0 mm. Type locality, Mazatlan, in *Spondylus*.

Material examined

New Caledonia, Lagon 1984, Ile Ouen, Baie du Prony, Stn 82, 22° 33 S, 166° 29' E, 10 m, 21Aug84: 14.1-5.4-5 mm. Coral 2, Mer de Corail, Stn CP07, Bank Lansdowne-Fairway, 20° 52' S 161° 37' E, 63-64 m, 20Jul88: 10.3-4.1-4.0 mm. NC, Expédition Montrouzier, TS, Platier au large du wharf de Touho, Stn 1242, 20° 46.2' S 165° 14.5' E, marée, blocs, sable, herbiers: 11.1-4.5-4.5 mm. TS, Banc de Touho, Stn 1259, 20° 46.6' S 165° 13.7' E, tombants avec limon, 15-35 m: 10.4-4.1-3.9 mm. TS, Haut-Fond de la Tié, Stn 1271, 20° 52.7' S 165° 19.5' E, tombants, sable sur dalle, 5-25 m: 15.9-5.5-5.5, 14.7-4.8-4.4, 12.6-4.7-4.5, 12.2-4.3-?, 12.0-4.5-4.6, 11.3-4.9-4.4, 10.3-2.4-2.1 mm. Oct93, KS, Anse de Koumac (= Baie de Ouapan), Stn 1277, 20° 34' S 164° 16' E, fonds meubles, herbiers, 0-2 m: 11.8-4.5-4.7 mm. KS, Paagoumène, Stn 1290, 20° 29.2' S 164° 10.2' E, marée, fonds meubles: 7.0-4.0-3.8 mm. KS, Pointe de Babouillat, Stn 1291, 20° 22.4' S 164° 06.8' E, intertidal: 7.3-3.1-3.0 mm. KS, Passe Deverd, Stn 1291, 20° 44.7' S 164° 15.5' E, dalle, 15-20 m: 6.6-3.6-3.4 mm. KS, Récif de l'Infernnet, Stn 1302, 20° 35.8' S 164° 12.7' E, pente interne, 9-10 m: 6.2 mm. KS, Chenal de l'Infernnet, Stn 1305, 20° 36.2' S 164° 11.0' E, sable gris, 12-15 m: 6.6-2.8-2.9 mm. KS, Passe de Koumac, Stn 1311, 20° 40.4' S 164° 14.9' E, fonds durs, 10-60 m: ~8 mm. KS, Grand Récif de Koumac, Stn 1318, 20° 41.4' S 164° 14.8' E, pente externe, 20-30 m: 11.6-4.4-4.0 mm, incomplet predation hole in left incrustation, (rv) ~5 mm. KS, Passe Deverd, Stn 1319, 20° 44.7' S 164° 15.5' E, dalle, 15-20 m: 7.6-3.3-3.1 mm. NC, Campagne Plouveal, Stn CP1376, 18° 27.2' S 163° 09.2' E, 39 m, Richer-IRD coll 09May1999: rv 12.7-5.0-(2.7 x2) mm. Campagne Paleo-Surprise, Stn DW1395, 18° 17.6' S 163° 01.9' E, 34-36 m, 13May99: rv 10.2(shell only 8.4)-4.2-(2.3x2) mm, incrustation ~ arista-



Fig. 9. *Lithophaga (Leiosolenus) mucronata*, 11.6-4.3-4.0 mm, right lateral view, from 20-30 m, dredgings, sands and coral fragments, Loyalty Islands, Lifu, Bay of Gaatcha, 20° 55.05' S 167° 03.35' E, Stn 1463, 10Nov2000. Image by P. Maestrati, MNHN.

Fig. 9. *Lithophaga (Leiosolenus) mucronata*, 11.6-4.3-4.0 mm, vista laterale destra, da 20-30 m, dredgings, sands and coral fragments, Loyalty Islands, Lifu, Bay of Gaatcha, 20° 55.05' S 167° 03,35' E, Stazione 1463, 10 Novembre 2000. Foto P. Maestrati, MNHN.

ta. Lifou 2000, SB, devant Kiki, Stn 1411, 20° 47.6' S 167° 10.35' E, sable entre patates, 4-8 m, 12-13Nov: lv 9.9-4.2-(2.0 x2), 9.1-4.2-(1.8 x2), 9.0-4.0-3.7 mm. SB, entre l'îlot Huca Hutighé, et la côte, Stn 1421, 20° 52.4' S 167° 08.5' E, sable grossier sur dalle, 4 m, 26-27Nov: 13.3-5.0-5.0, 11.2-4.3-4.1, 10.8-4.4-4.2, 10.6-4.7-4.5 mm. SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1429, 20° 47.5' S 167° 07.1' E, patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 10.8-5.1-4.5, 10.7-4.6-?, 10.7-4.7-4.1, 10.5-4.1-3.6, 10.4-4.3-3.7, 9.7-3.9-3.5, 9.6-4.1-3.7, 9.4-4.1-3.9, 9.0-4.1-3.8, ~9, 8.5-3.6-3.4, 7.2-3.3-3.3, 7.3-3.1-3.1, rv 9.2-4.0-(2.0 x2). SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1429, 20° 47.5' S 167° 07.1' E, patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 9.7-4.2-3.7 mm. GB, Stn 1436, 20° 55.5' S 167° 04.2' E, patate corallienne sur tombant, 10-20 m, 10Nov: 9.0-3.5-3.2 mm. SB, Stn 1443, 20° 53.8' S 167° 07.3' E, devant Peng, tombant, 48-52 m, 14Nov: rv 6.8-3.1-(1.5 x2) mm. SB, Stn 1450, au Nord du Cap Aimé Martin, 20° 45.8' S 167° 01.65' E, brossages, 27-31 m, 7/21Nov: lv 11.3-4.9-(2.3 x2), rv 10.7-4.7-(2.2 x2), 6.2-2.6-2.5 mm. SB, Ouest de la Pointe d'Easo, Stn 1451, 20° 47.3' S 167° 06.8' E, 2^{ème} patate corallienne, 10-21 m, 19Nov: 11.2-4.9-4.9, 9.5-3.7-3.4 mm. As before: rv 15.1(~12.5)-5.4-(2.7 x2) mm. SB, Stn 1453, entre la Cap Mandé et le Cap Lefèvre, 20° 54.6' S 167° 02.1' E, tombant massif avec Gorgones, 21-30 m, 22Nov: 10.2-4.5-4.2, 8.7-3.7-3.2, 8.0-3.2-2.9, 6.6-2.7-2.6 mm. SB, Stn 1455, entre le Cap Wekutr et le Cap Wajez, 20° 56.8' S 167° 02.7' E, tombant, 15-20 m, 25Nov: 14.5-5.7-5.7, 12.8-4.7-4.5, 10.6-4.5-4.4, 10.6-4.5-4.3, 10.0-3.7-3.5, 9.9-3.8-3.5, 9.5-3.9-3.5, 8.8, 8.8-3.4-3.5, 8.7, 8.7, 8.4-3.6-3.2, 7.8, 7.6, 5.5-2.5-2.5, 4.5, lv 10.6-4.7-(2.2 x2), rv 10.1-4.4-(2.0 x2), lv 8.7-3.6-(1.6 x2). As before: 11.3-4.5-4.5 mm. SB, NE de la baie, au niveau de Cila, Stn 1456, 20° 49.3' S 167° 10.4' E, tombant, 25-30 m, 26Nov: 14.5-5.2-5.3, 6.8-3.2-? mm. SB, face à la plage de Ngoni, Stn 1459, 20° 47.0' S, 167° 03.0' E, dragages, 55-60 m, 5/13Nov: 8.8-3.6-3.3 mm. As before: 10.4-4.4-4.5, 7.5-3.4-3.2 mm. As before: 16.6-5.6-5.4, 15.0-5.9-5.0, 15.6-6.0-5.7, 12.0-5.1-4.8, 11.0-4.8-4.5, 11.0-4.6-4.4, 10.5-4.4-4.3, 10.3-4.5-4.4, 10.2-3.9-3.5, 10.0-4.3-4.2, 9.3-4.1-4.0, 9.3-3.8-3.6, 9.0-3.8-3.7 mm, 8.8-4.1-3.8, 8.5-3.5-3.3, 8.0-3.6-3.7, 6.3-2.8-2.9, 5.0-2.1-2.0 mm, dead: rv 14.6(~11.5)-5.0-(2.4x2), lv 13.6-5.5-(2.8x2), rv 13.5-5.4-(2.8x2), rv 11.0-4.5-(2.1x2), rv 10.6-4.2-(2.2x2) mm, lv 8.7-3.7-(1.6x2), rv 8.8-3.7-(1.6x2) mm, 8.1~3.5-? mm in dead coral fragment, lv 8.1-3.1-? (+predation hole), rv 7.7-3.1-(1.5x2) mm, rv 7.0-3.3-(1.6x2) mm. GB, Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sables et débris coralliens, 20-30 m, 10Nov: 11.6-4.3-4.0 (Fig. 9), 10.5-4.6-4.6, 10.2-4.2-4.0, 8.5-3.7-3.3, 7.9-3.6-3.2 mm. SB, devant Peng, Stn 1464, 20° 54.5' S 167° 05.9' E, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 15.6(~13.5)-6.2-? (attempts of predation holes in rv), 12.6-5.5-5.4, 11.6-4.6-4.2, 10.7-4.4-4.0 (+ predation hole), 8.7-3.7-3.3, 8.7, 8.4-3.5-3.3 mm. SB, de part et d'autre de la Pointe d'Easo, Stn 1465, 20° 47.7' S 167° 07.0' E, dragages, blocs et coraux, 35-44 m, 16Nov: 8.0-3.7-3.4 mm. SB, Baie de Hunetë, Stn 1466, 20° 46.5' S 167° 06.2' E, dragages, blocs coralliens, 25-45 m, 17Nov: rv 10.4-4.3-(2.1 x2) mm. PH, Panglao 2004, Panglao Island, Stn B3,

Arco Point, 9° 33.5' N, 123° 48.6' E, base of reef slope, 8 m, 31May: 9.0 mm (Fig. 8A-C). Pamilacan Island, Stn B24, 9° 29.4' N, 123° 56.0' E, floor of cave, 38 m, 25Jun, 10.3 mm.

L. (Leiosolenus) sp., ~mucronata (Philippi, 1846): Mozambique Channel, Benthedi 1977, Banc du Geyser, St 117, Lagon partie sud, 8-9 m: ~9 mm, broken. Reunion Island, MD 32, 1982, Stn DC85, 21° 00' S, 55° 15' E, 58-70 m: 6.8-3.0-2.8 mm. New Caledonia, Expédition Montrouzier, KS, Stn 1297, 20° 34.5' S 164° 15.5' E, Baie de Koumac, 3-7 m, vase à caulerpes: ~5.5~2.5-?, ~4.5, 3, < 3 mm. KS, Stn 1318, 20° 41.4' S 164° 14.8' E, Grand Récif de Koumac, pente externe, 20-30 m: 12.1-5.2-5.1 mm. Lifou 2000, SB, Est de la Baie du Santal, Stn 1446, 20° 50.8' S 167° 09.7' E, Mepinyo, bas du tombant, 36-40 m, 16Nov: ~5.5 mm. SB, NE de la Baie, au niveau de Cila, Stn 1456, 20° 49.3' S 167° 10.4' E, tombant, 25-30 m, 26Nov: 10.2-3.7-3.6, 9.5-4.1-3.6 mm. SB, Stn 1457, devant Ngoni, 20° 46.8' S 167° 02.75' E, surplomb sciophile et blocs, 5-10 m, 27Nov: <3 mm. SB, Est de la baie, Stn 1460, devant l'îlot Huca Hutighé, 20° 52.4' S, 167° 08.0' E, dragages, 40-60 m, 06Nov: rv 14.6, lv 14.5, 12.5-4.7-4.3 mm. SB, Arrête au SE de la Pointe Aimé Martin, Stn 1462, 20° 47.1' S 167° 03.2' E, dragages, 70-120 m, 9/21Nov: rv 6.6 mm. SB, de part et d'autre de la Pointe d'Easo, Stn 1465, 20° 47.7' S 167° 07.0' E, dragages, blocs et coraux, 35-44 m, 16Nov: 12.3-5.0-4.5, 10.6-4.2-3.9, 10.3-4.7-4.4, 10.0-4.0-3.6, 6.6-2.7-2.3 mm.

Diagnosis

Shell short, stout. Posterior incrustation solid, projecting pointed, extremity obliquely dropping anteriorly, inner faces concave.

Description

Shell less than 20 mm long, subcylindrical, stout, anterior hemispherical, posterior shell rim obliquely cut towards the ventral rim. Umbos sub-terminal, relatively prominent as well as the two lines, running from the umbos postero-ventrally, between which the thickening incrustation develops. Laterally, the incrustation sometimes shows a series of narrow, semi-vertical ridges and wider spaces between, filled with less dense deposits. Further posteriorly, the incrustation appears generally solid, smooth and prominent, protruding beyond the shell rim in a thick, short stump, obliquely cut towards the anterior, with normally sharp-edged, concave lips, terminating more dorsally in a stout spur. Periostracum in various shades of brown, dorsal angle generally past the middle of the shell and distinct.

Remarks

Philippi (1846: p. 4/150) points out that the dorsal line in front of the angle is absolutely parallel to the ventral line. This seems true for the figured type (Philippi, 1846: pl. 1, fig. 8), but not generally. In *mucronata*, the poste-

rior is dominated by the prominent incrustation, changing the outline of the original shell more than in other species in relation to shell form and length. Past the usually elevated dorsal angle, the dorsal outline often builds a depression (concave angle) where the descending shell rim vanishes under the relatively thick posterior incrustation. Past the shell, when valves are shut, the inner faces of the protrusion enclose a kind of cavity. The incrustation terminates pointed, somewhat dorsally, in a short spur. In the larger *L. lithura*, the spurs elongate the lateral mid-line of the valves (Pilsbry, 1905: pl. 5, figs 37-39), while in *L. aristata* (Dillwyn, 1817) they form a 'cross-bill' (Morton, 1993; Simone & Gonçalves, 2006). *L. mucronata* is a dead-coral borer. Largest observed specimen 16.6 mm, recorded depth range in the present material 4 to 64 m. *L. calyculatus* is based on the type only.

Lithophaga (Leiosolenus) nasuta (Philippi, 1846) (Fig. 10A-C)

Modiola nasuta Philippi, 1846: p. 3/149, pl. 1, fig. 2. Kleemann, 1983: p. 16 = (*Leiosolenus*) *nasuta*. Kleemann, 1984: fig. 17. *Lithodomus nasutus* (part) Reeve, 1857: sp. 10, pl. 2, fig. 10b (non 10a = *Lithophaga lima* Lamy, 1919). *Lithophaga nasuta* (part) Dunker, 1882: p. 5, pl. 1, figs 5, 6 (non pl. 2, figs 7, 8 = *L. lima*). *Lithophaga cumingiana* (non Reeve) Otter, 1937: pp. 325, 334, 341-346, 348, 352, text-figs 2-4, pl. 1, fig. 1/5. *Lithophaga (Myapalmula) dichroa* Iredale, 1939: pp. 417, 421, pl. 6, fig. 31. Wilson, 1979: fig. 17/2a, b (holotype) = *nasuta*. Kleemann, 1984: fig. 18 (holotype) = *nasuta*. *Lithodomus lithophaga* (non Linnaeus) Macnae & Kalk, 1958: pp. 37, 90, 119, 129, text-fig. 23a. *Lithophaga nasuta* Philippi - Wilson, 1979: pp. 457-461. *L. (Leiosolenus) nasuta* (Philippi) - Kleemann, 1984: pp. 205-210. Kleemann, 2010: pp. 502, pl. 942, fig. 7 (non fig. 5 = *L. pulchra* Lamy, 1919). *Leiosolenus (Leiosolenus) nasutus* (Philippi) - Huber, 2010: p. 120, left figure in 1st row.

Types

The type of *nasuta*, MHNHS 50391 (Maria Codoceo R. pers. comm.) is probably lost. Lectotype (here designated), MHNHS 50344, 68.9-20.8-16.6 mm (Kleemann 1984: fig. 17). Type locality, Pacific Ocean. AM C60404, holotype of *dichroa*, 57.9-17.8-14.3 mm (Kleemann, 1984: fig. 18). Type locality, Low Isles, Queensland.

Material examined

New Caledonia, Lifou 2000, GB, Stn 1463, 20° 55.05' S 167° 03.35' E, dragages, sables et débris coralliens, 20-30 m, 10Nov: >25-10-? mm. Philippines, Panglao 2004, Pamilacan Island, Stn B11, 9° 29.4' N, 123° 56.0' E, coral rubble, 2-4 m, 11Jun: 18.3-6.0-5.2 (Fig. 10A-C), 13.6-4.7-4.0 mm. Bohol Island, Stn M24, 9° 42.1' N, 123° 51.3' E, Manga Point, mangrove and mixed intertidal, 0-1 m, 17Jun: 22.0-7.3-5.5, 13.6-4.6-4.0 mm. *L. (Leiosolenus) ? nasuta* (Philippi, 1846): As before, Stn B11, 9° 29.4' N, 123° 56.0' E, 2-4 m, 11Jun: 20.3-7.4-6.3 mm.

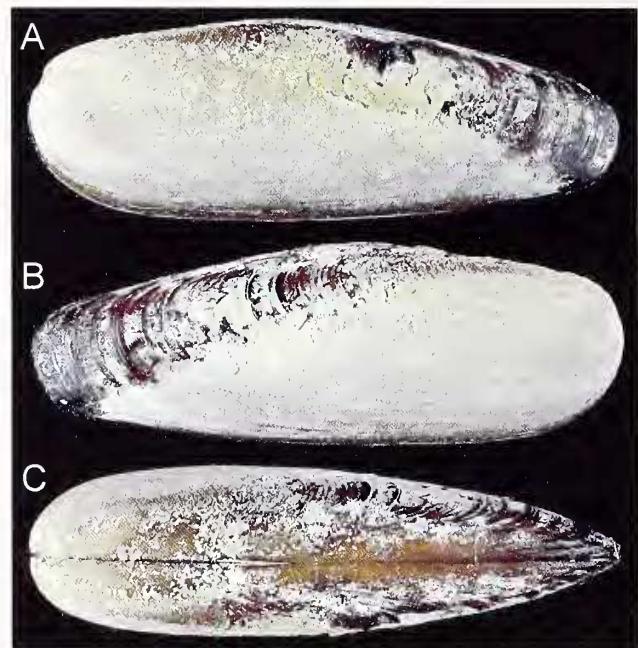


Fig. 10. *Lithophaga (Leiosolenus) nasuta* (Philippi, 1846), 18.3-6.0-5.2 mm, **A**, left lateral, **B**, right lateral, and **C**, dorsal view, from 2-4 m, coral rubble, Pamilacan Island, Philippines, 9° 29.4' N, 123° 56.0' E, Stn B11, 11Jun04. Images by P. Maestrati, MNHN.

Fig. 10. *Lithophaga (Leiosolenus) nasuta* (Philippi, 1846), 18.3-6.0-5.2 mm, **A**, vista laterale sinistra, **B**, vista laterale destra, e **C**, vista dorsale, 2-4 m, detrito corallino, Pamilacan Island, Filippine, 9° 29,4' N, 123° 56,0' E, Stazione B11, 11 Giugno 2004. Foto P. Maestrati, MNHN.

Diagnosis

Shell and incrustation smooth, not projecting, periostracum dark between sulci.

Description

Shell subcylindrical, smooth, ornamented only by some posteriorly elevated growth lines. Anterior extremity lifted above longitudinal midline. Anterior dorsal line almost parallel to ventral line before the latter curves up steeply. Dorsal angle inconspicuous, posterior dorsal line straight, posterior wedge-shaped, minimally attenuated, more or less covered by a smooth adhesive incrustation, not protruding beyond the valves. Periostracum brown, somewhat bicoloured, the sector between the sulci being darker pigmented.

Remarks

Dead-coral borer, particularly in flat upper surfaces, size up to 80 mm (Kleemann 1984). The recorded depth of 0-4 m at the Philippines corresponds well to what Kleemann observed in 1974 at Lizard Island, Great Barrier Reef of Australia. A depth range to 20 m is reported from China (Bernard et al., 1993).

Lithophaga (Leiosolenus) obesa (Philippi, 1847) (Fig. 11A-C)

Modiola (Lithophagus) obesa Philippi, 1847a: p. 118. *Modiola obesa* Philippi, 1847: p. 5/19, pl. 2, fig. 2. *Lithodomus obesus* Philippi - Reeve, 1858: sp. 6, pl. 1, fig. 6.

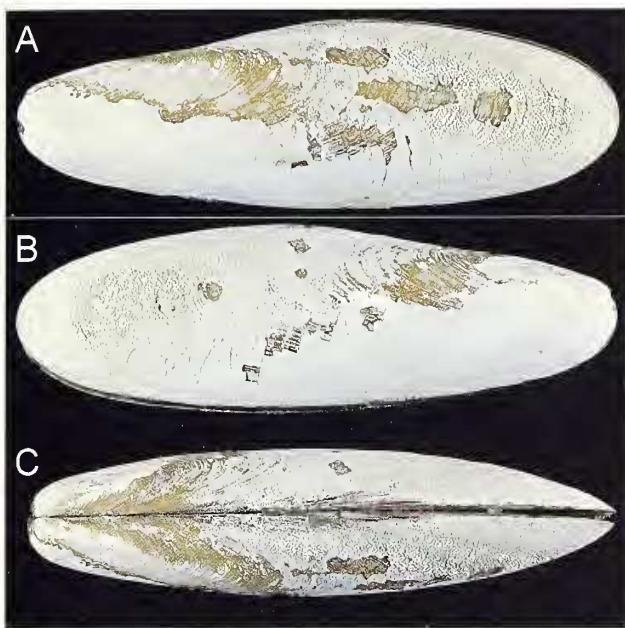


Fig. 11. *Lithophaga (Leiosolenus) obesa* (Philippi, 1847), 103.3-32.8~24 mm (valves slightly gaping), **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 8-22 m, damaged coral reef, Baclayon Takot, Bohol Island, Pangalo region, Philippines, 9° 37.1'N, 123° 52.6'E, Stn R42, 12Jun04. Images by P. Maestrati, MNHN.

Fig. 11. *Lithophaga (Leiosolenus) obesa* (Philippi, 1847), 103.3-32.8~24 mm (valve leggermente beanti), **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 8-22 m, scogliera corallina danneggiata, Baclayon Takot, Bohol Island, area di Pangalo, Filippine, 9° 37.1'N, 123° 52.6'E, Stazione R42, 12 Giugno 2004. Foto P. Maestrati, MNHN.

Lithophaga obesa Philippi - Dunker 1880-83: p. 6 (1882), pl. 1, fig. 9-10, pl. 3, figs 1-2 (1880). Lamy 1919: p. 255. Otter 1937: pl. 1, fig. 1/6, pl. 2, fig. 2. Wilson, 1979: pp. 474-476. Barthel, 1982: pp. 649-659.

Dactylus yacoubi Jousseaume MS - Lamy, 1919: p. 255 = *L. obesa*. Kleemann, 1984: fig. 29 (syntypes = *L. obesa*).

Lithophaga (Leiosolenus) obesa Philippi - Lamy, 1937: pp. 118-119. Barthel, 1982: pl. 1, figs 1-6. Kleemann, 1984: pp. 218-223. Kleemann, 2010: p. 500, pl. 941, figs 3, 4a, b.

Lithophaga hawaiiensis Dall, Bartsch & Rehder, 1938: pp. 56, 57, pl. 11, figs 9, 10. Kleemann, 1983: p. 11. Kleemann, 1984: pp. 218, 219, figs 26 (holotype), 28.

Lithophaga obesa suspecta Iredale, 1939: pp. 422, 423, pl. 6, fig. 30. Allan, 1950: p. 294, text-fig. 69/1. Wilson, 1979: fig. 17/1a, b (holotype = *L. obesa*). Kleemann, 1983: p. 17. Kleemann, 1984: pp. 218, 219, fig. 25 (holotype).

Leiosolenus obesus (Philippi) - Nielsen, 1986: p. 6, fig. 2G. Oliver, 1992: p. 54, 228, pl. 7, fig. 4a, b. Oliver, 1995: p. 218, fig. 964.

Leiosolenus obesa (Philippi) - Oliver, 1992: p. 47, text-fig. 26.

Types

The type of *Modiola obesa* Philippi, 68.0-26.3-19.7 mm (Kleemann 1983: 17), is probably hidden in the collection of MNHNS (Kleemann 1984: p. 218). Type locality, China? "Neotype" is the holotype of *L. obesa suspecta* (Wilson, 1979: p. 474; Kleemann, 1984: pp. 218, 219, fig. 25), AM C60407, 81.8-28.6-20.6 mm. Type locality, Low Isles, Queensland. MNHN, syntypes of *Dactylus yacoubi*, 58.3 mm respectively 75.0 mm in length (Kleemann, 1984: fig. 29). Type locality, Djibouti. USNM337459, holotype of *L. hawaiiensis*, 68.0-26.4-19.6 mm (Kleemann, 1984: fig. 26). Type locality, Honolulu.

Material examined

New Caledonia, Lagon, Secteur de Pouébo, Stn 886, 20° 24' S 164° 41' E, 20 m, 14Jan87: fragment of a right valve (predation hole), <2 mm. Expédition Montrouzier, TS, Stn 1242, Platier au large du wharf de Touho, 20° 46.2' S 165° 14.5' E, marée, blocs, sable, herbiers, Sep 93: 63.2-23.8-18.0, 46.8-17.2-13.3, 39.4-14.0-10.8 mm. Lifou 2000, GB, Stn 1419, 20° 55.6' S 167° 04.5' E, limon sur dalle, algues photophiles, 5 m, 10Nov: 67.8-24.8-27.5, 49.5-19.3-15.1, 36.0-13.3-?, 27.1-10.7-8.0, 26.9-10.4-7.7 mm. SB, Stn 1421, 20° 52.4' S 167° 08.5' E, entre l'îlot Huca Hutighé et la côte, sable grossier sur dalle, 4 m, 26-27Nov: 70.4-25.8-19.4, 56.6-20.2-15.3 mm. As before: 51.0-18.8-14.6, 27.0-10.5-8.0 mm. GB, Stn 1424, vers le Cap Mandé, 20° 54.9' S 167° 03.0' E, sable fin et algues photophiles sur dalle, 4 m, 15Nov: 62.0-21.1-15.4, 55.2-20.4-15.0, 54.6-19.6-15.7, 51.0-19.6-14.5, 31.0-11.1-8.0, 29.8-11.3-8.6 mm. GB, Stn 1436, 20° 55.5' S 167° 04.2' E, patate corallienne sur tombant, 10-20 m, 10Nov: 45.1-17.7-13.2 mm. As before: 67.1-23.7-18.8 mm, in dead *Porites*, borehole ~ 90 mm in length and 26 mm in width, 'bottleneck' widens from 17 to 29 mm at surface. SB, au Nord du Cap Aimé Martin, Stn 1450, 20° 45.8' S 167° 01.65' E, brossages, 27-31 m, 17/21Nov: 73.4-28.0-21.1 mm. SB, Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: 18.7-7.4-6.0 mm. SB, Stn 1459, 20° 47.0' S, 167° 03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 35.5-13.9-10.8 mm. Philippines, Panglao 2004, Bohol Island, Stn R42, 9° 37.1'N, 123° 52.6'E, Baclayon Takot, damaged coral reef, 8-22 m, 12Jun04: 103.3-32.8-?24, 74.0-28.3-?21 mm (both gaping a little, **Fig. 11A-C**). Vanuatu, Santo 2006, Palikulo Bay, Stn FR27, 15° 28.7' S, 167° 15.1' E, 36-40 m, 22Sep2006: 69.6-27.8-23.9 mm.

L. (Leiosolenus) ? obesa (Philippi, 1846): New Caledonia, Expédition Montrouzier, TS, Haut-Fond de la Tié, Stn 1271, 20° 52.7' S 165° 19.5' E, tombants, sable sur dalle, 5-25 m: 17.6-6.7-5.2 mm.

Diagnosis

Big-growing *Leiosolenus*, height and posterior inflated, incrustation not projecting.

Description

Shell reaching over 100 mm in length, outline sub-elliptical, only hinge line straight, others convex. Anterior narrowly, posterior widely semi-circular in lateral view, anterior hemispherical, posterior wedge-shaped, much higher in height. Periostracum yellow to light brown, covered by deposits. The inflated posterior is conspicuous, together with the thin, fine-grained incrustation on it species-specific, thickening not very much towards the shell rim without projecting beyond it. For further details see Kleemann (1984).

Remarks

Depth range of the present material is 4-60 m and the

largest specimen reached 73.4 mm. Barthel (1982) and Kleemann (1984) provided detailed descriptions including the borings. *L. hawaia* is known only from a few (sub-) fossil specimens.

Lithophaga (Leiosolenus) paraplumula n. sp.
(Figs 12A-C, 13A-C)

Lithophaga paraplumula n. sp. - Kleemann, 2004: pp. 31 (nomen nudum).

Types

Holotype MNHN 25599: 14.2-5.5-4.9 mm (Fig. 12A-C), 2 paratypes MNHN 25600, paratype 1: 13.3-4.7-4.6 mm (Fig. 13A-C), paratype 2: 15.3-5.4-4.7 mm. Type locality, New Caledonia, Loyalty Islands, Lifou, Santal Bay, face à la plage de Ngoni, dragages, 55-60 m, 20°47.0' S, 167°03.0' E, 5/13Nov2000 Stn 1459.

Material examined

New Caledonia, Lifou 2000, SB, Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: 13.2-5.3-4.7 mm. SB, Stn 1459, 20°47.0' S, 167°03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 13.3-5.2-4.6, 12.9-5.2-4.6, 12.7-4.9-4.2, 12.3-5.5-4.5, 12.1-4.7-4.4, 12.0-4.9-4.4, 12.0-4.7-4.0, 12.0-4.5-4.1, 11.7-4.6-4.2, ~11.5, 11.4-4.8-4.2, 11.3-4.6-4.2,

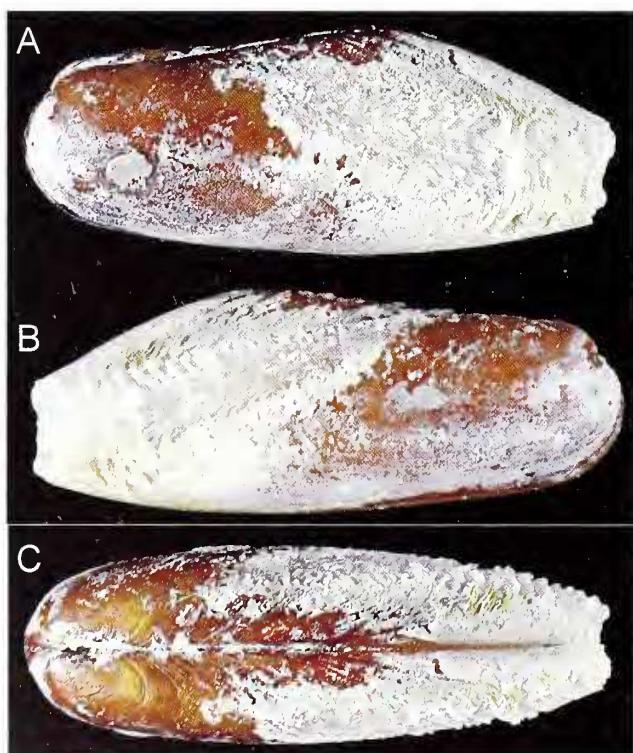


Fig. 12. *Lithophaga (Leiosolenus) paraplumula* n. sp., holotype, 14.2-5.5-4.9 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 55-60 m, front of Ngoni Beach, dredgings, Loyalty Islands, Lifou, Bay of Santal, Stn 1459, 20°47.0' S, 167°03.0' E, 5/13Nov2000. Images by P. Maestrati, MNHN.

Fig. 12. *Lithophaga (Leiosolenus) paraplumula* n. sp., olotipo, 14.2-5.5-4.9 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 55-60 m, di fronte a Ngoni Beach, gragaggi, Loyalty Islands, Lifou, Bay of Santal, Stazione 1459, 20°47.0' S, 167°03.0' E, 5-13 Novembre 2000. Foto P. Maestrati, MNHN.

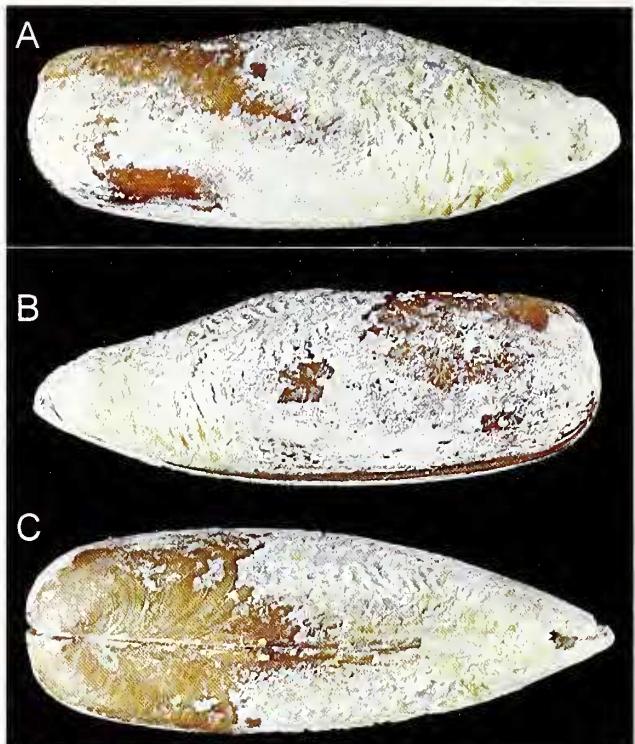


Fig. 13. *Lithophaga (Leiosolenus) paraplumula* n. sp., paratipo 1, 13.3-4.7-4.6 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 55-60 m, etc. as for holotype. Images by P. Maestrati, MNHN.

Fig. 13. *Lithophaga (Leiosolenus) paraplumula* n. sp., paratipo 1, 13.3-4.7-4.6 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 55-60 m, etc. come per l'olotipo. Foto P. Maestrati, MNHN.

11.0-4.2-3.9, 10.9-4.3-4.2, 10.9-4.2-4.1, 10.9-4.1-3.7, 10.7-4.2-4.1, 10.7-4.0-3.3, 10.2-4.4-4.2, 10.2-4.3-3.7, 10.1-4.1-3.9, 10.0-4.0-3.8, 9.2-4.3-4.3, 8.8-3.6-3.4, 8.4-3.3-2.8, 8.0-3.1-?, 7.6-3.5-3.2, 7.6-3.0-2.7, 7.3-2.8-2.6, ~5 mm, dead: lv 13.8-4.7-(2.3x2), lv 13.7-4.9-(2.3x2), lv 13.4-5.0-(2.2x2), rv 13.2-4.8-(2.3x2), rv 13.2-4.5-(2.3x2), rv 12.4-4.7-(2x2) (~ *dahabensis*), lv 11.6-4.8-(2.1x2), rv 8.4-3.0-(1.5x2), rv 7.1-2.8-(1.3x2) mm. As before: 13.4-5.2-4.5, 12.9-4.4-4.2, 11.3-4.0-3.5, 10.9-4.2-4.1 mm. Philippines, Panglao 2004, PI, Cataraman, Stn B7, 4-30 m, reef slope with caves, 9° 35.9' N, 123° 51.8' E, 05Jun: 10.8-4.0-3.8 mm. PI, Napaling, Stn B9, 9° 33.1' N, 123° 44.0' E, caves in the reef wall, 8-10 m, 08Jun: 11.5-4.5-4.2 mm. PI, Doljo Point, Stn B12, 9° 36.6' N, 123° 43.2' E, reef slope, 24-27 m, 14Jun: 8.1 mm. PI, Bingag, Stn B16, 9° 37.6' N, 123° 47.3' E, coral rubble on sand and gravel, 20 m, 17Jun: 8.1, lv 7.7, 7.6, 6.6 mm. Balicasag Island, Black Forest, Stn B23, 9° 31.1' N, 123° 41.3' E, rubble and sand, 20-25 m, 25Jun: 8.0 mm. Bohol Island, Cortes Takot, Stn B13, 9° 37.1' N, 123° 52.6' E, coral rubble, 3-5 m, 15Jun: 8.3 mm. PI, Sungcolan Bay, Stn B14, 9° 38.5' N, 123° 49.2' E, coral rubble, 2-4 m, 16Jun: lv 13.1-5.8-(2.7x2) mm. PI, Napaling, Stn B21, 9° 37.2' N, 123° 46.4' E, reef wall with small caves, 20-21 m, 24Jun: 9.1 mm. PI, Pontod Lagoon 1, Stn B39, 9° 32.8' N, 123° 42.1' E, reef wall with small caves, 17-25 m, 02Jul: 8.0, 7.7 mm. BAI, Stn B41, 9° 30.9' N 123° 40.8' E, floor of large cave, 17-19 m, 04Jul: 12.2-4.2-3.9 mm. As before: 7.9 mm. BAI, Stn L42, 9° 31.2' N, 123° 40.7' E, 80-90 m, 02Jul: 12.3-4.7-4.2 mm. PI, Napaling, Stn M22, 9° 37.2' N, 123° 46.4' E, coral platform, 0-3 m, 15Jun: 11.2-4.1-4.0 mm. Vanuatu, Santo 2006, S Aoré Island, Stn

DB12, 15° 36.8' S, 167° 10.1' E, on sand, with dead corals, 10-18 m, 13Sep: lv 13.5, rv 13.1 mm. S Tutuba Island, Stn DB16, 15° 35.5' S, 167° 15.8' E, sand with coral patches, 32-40 m, 14Sep: 10.0 mm. NW Urélapa Island, Stn DB20, 15° 35.5' S, 167° 01.4' E, sand with coral patches, 22-25 m, 29Sep: 11.0-4.0-3.6, 10.0, 9.7, 7.8, rv 7.0, 6.0, 5.8 mm, disarticulated. As before: 7.6 mm. W Malo Island, Stn DB29, 15° 38.9' S, 167° 05.1' E, sand around coral patches, 15 m, 17Sep: 14.1-5.3-4.6, 10.8-4.2-4.0, 10.0-3.8-3.5 mm. As before: lv 15.6, 15.3-4.8-4.6, lv 13.2, rv 9.2, rv 9.9, 9.6, 8.7 mm, broken. W Malo Island, Stn DB48, 15° 38.7' S, 167° 05.2' E, sand with rubble, 10-17 m, 21Sep: 12.6-4.1-3.9, 8.4 mm. Bruat Channel, N coast of Malo Island, Stn DB80, 15° 37.1' S, 167° 07.5' E, sand and corals on submarine hill, 18 m, 02Oct: 11.2-4.3-4.4, 10.8-4.0-3.5, 10.3-4.0-3.3, 8.9-4.0-3.8, 8.5 mm. S Aoré Island, off Aimbuei Bay, Stn EP34, 15° 33.2/33.3' S, 167° 12.8/12.9' E, tangle net, 40-60 m, 14Oct: lv 10.6 mm. Palikulo Bay, Stn FB43, 15° 28.4' S, 167° 14.9' E, massive dead corals, 19 m, 29Sep: 13.4-4.5-3.8 mm. Segond Channel, NW Aoré Island, Stn FS77, 15° 33.1' S, 167° 09.6' E, coral patches on steep wall, 29 m, 14Oct: 9.8 mm. Turtle Bay, Stn LD07, 15° 19.8' S, 167° 11.1' E, 1-3 m, 28Sep: 10.4-4.2-4.0 mm. SW Drelapa Island, Stn ZB06, 15° 36.8' S, 167° 01.3' E, 30 m, 28Sep: 9.0, ~9, 8.0 mm. W coast of Malo Island, Stn ZB09, 15° 40.6' S, 167° 05.1' E, 5-7 m, 02Oct: 9.5, 9.1 mm. Segond Channel, Coolidge wreck, Stn ZB24, 15° 31.4'S, 167° 14.1'E, 26 m, 12Oct: 10.2 mm.

Lithophaga ? *paraprumula* n. sp., Philippines, Panglao 2004, BOI, Ubajan, Stn B20, 9° 41.5' N, 123° 51.0' E, rocks and corals with sand and mud, 2-8 m, 23Jun: rv 7.3, 4.5 mm. PI, Sungcolan Bay, Stn B18, 9° 38.5' N, 123° 49.7' E, blocks dispersed among seagrass, 3-5 m, 20Jun: 13.4 mm, broken, 6.5 mm. Vanuatu, Santo 2006, S Tutuba Island, Stn DB16, 15° 35.5' S, 167° 15.8' E, sand with coral patches, 32-40 m, 14Sep: 9.4 mm. W Malo Island, Stn DB29 15° 38.9' S, 167° 05.1' E, 15 m, 17Sep: 10.9, lv 9.2 mm. SE Aésé Island, Stn DB63, 15° 26.9'S, 167° 15.8'E, sand, dead and live corals, 21m, 25Sep: 11.4 mm. Palikulo Bay, Stn DB65, 15° 25.8' S, 167° 13.0' E, sand and coral patches, 13 m, 26Sep: 10.0 mm. Palikulo Bay, Stn DB69, 15° 24.4' S, 167° 13.0' E, sand and coral patches, 38 m, 27Sep: rv 9.5 mm. Palikulo Bay, Stn DB77, 15° 27.9' S, 167° 14.7' E, sandy, rocky slope, 42-45 m, 29Sep: 8.7, 6.9 mm. Palikulo Bay, Stn FB43, 15° 28.4' S, 167° 14.9' E, massive dead corals, 19 m, 29Sep: 5.0 mm. Elia Island, Stn FB72, 15° 36.1' S, 166° 58.5' E, sand with dead corals, 16 m, 12Oct: rv10.3 mm.

Etymology

The name refers to the similarity of the species to the larger Eastern Pacific *plumula* (Hanley, 1843).

Diagnosis

Small “*Diberus*” Dall, 1898, posterior incrustation pattern a mix of *malaccana* and *plumula*, posteriorly protruding spur of incrustation hollow between its halves, periostracum dark brown, dorsal angle prominent.

Description

Shell subcylindrical, small, probably up to 25 mm in length, posteriorly truncated, camouflaged by protruding incrustation, dorsal angle usually prominent, thus shell height greater in comparison to similar-sized species. Anterior hemispherical, posterior wedge-shaped to conical because of incrustation, ventral margin slightly convex, hinge (ligament) straight and long. Anterior part, in front of dorsal angle, about two thirds of actual shell length without its projecting posterior incrustation. The latter consists of fine, posteriorly directed, diverging and crossing ridges, building basally a narrow rhomboidal meshwork, gradually becoming wider and thicker, while on the elevated surface pronounced vertical interconnections resemble steep ripple marks. Voids may be filled with less dense calcareous deposits, detritus and remains of mucus secretions, then building a rather smooth posterior, ending in a broad spur, pointed and enclosing a pocket-like hollow. Periostracum commonly dark brown, may be reddish, rarely light brown.

Remarks

Specimens reach about half the size of *L. plumula* and display a much lighter posterior incrustation, being less strongly plume shaped and mixed with a reticulated pattern. In spite of the many Philippine localities, the types were chosen from a New Caledonian locality because of a comparably high number of specimens available. The recorded depth ranges from 15 to 60 m at Lifou, from 0 to 90 m at the Philippines, and from 1 to 60 m at Vanuatu. A dead coral substratum as habitat may be assumed, particularly from the rather heavy posterior incrustation in relation to shell size and the wide depth range.

Lithophaga (Leiosolenus) parapurpurea
Kleemann, 2008

Lithophaga purpurea Kleemann, 1980a: only from *Cyphastrea* and *Echinopora* (fig. 12 and 13, respectively). Kleemann, 1992: p. 8, from *Cyphastrea* and *Echinopora*. Kleemann, 1995: only from *Cyphastrea* and *Echinopora*.

Lithophaga (Leiosolenus) parapurpurea Kleemann, 2008: pp. 37, 40, figs 2A-C, 2I, 3A.

Types

Holotype, IPUW200800010001, 15.0-6.2-5.2 mm (Kleemann, 2008: fig. 2A). Paratypes, IPUW200800010002-4, 14.8-6.0-5.3 mm, 13.5-5.6-5.2 mm and 11.5-5.2-4.3 mm, respectively. Host coral of all types, *Cyphastrea microphthalma*, IPUW3861. Type locality, Makunudoo, N. Male Atoll, Maldives, 4°31'50,51" N, 73°25'21,54" E.

Material examined

New Caledonia, Lifou 2000, SB, Stn 1426, 20° 45.9' S,

167° 06.2' E, devant Hunetë, dalle et petites poches de sédiment, 4-7 m, 20Nov: 14.6-5.2-4.1 mm. SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1429, 20° 47.5' S 167° 07.1' E patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 12.5-4.9-4.3, 9.0-3.9-3.1, 8.0-3.3-2.9, rv ~10.5 mm. SB, Ouest/Sud-Ouest de la Pointe d'Easo, Stn 1431, 20° 47.5' S 167° 07.1' E, récoltes à vue, 18-35 m, 3/5/7/9/17/23-24Nov: 7.7-4.2-3.5 mm. GB, Stn 1436, 20° 55.5' S 167° 04.2' E, patate corallienne sur tombant, 10-20 m, 10Nov: lv 11, rv 10.7, lv 9.6, rv 9.3, 9.0-4.0-3.6 mm. SB, Stn 1455, 20° 56.8' S 167° 02.7' E, entre le Cap Wekutr et le Cap Wajez, tombant, 15-20 m, 25Nov: 13.3-5.2-4.5, 12.4-4.6-3.7, 12.1-4.5-3.9, ~12, 11.3-4.3-4.0, 11.3-4.3-3.7, 11.2-4.7-3.5, ~11, >10, ~10, >9, ~9, ~3.5 mm. SB, Est de la baie, Stn 1460, 20° 52.4' S, 167° 08.0' E, devant l'îlot Huca Hutighé, dragages, 40-60 m, 06Nov: lv 10.8, 8.4-3.8-3.0 mm. SB, Stn 1464, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 20° 54.5' S 167° 05.9' E, 14Nov: 11.4-4.6-4.0, 9.4-4.3-3.4, 5.7-2.9-2.1 mm. SB, Stn 1465, 20° 47.7' S 167° 07.0' E, de part et d'autre de la Pointe d'Easo, dragages, blocs et coraux, 35-45 m, 16Nov: ~15.9-5.3 mm. As before: several specimens in host coral *C. microphthalma*, 65 x 51 x 15 mm (Kleemann, 2008, fig. 2G). Vanuatu, Santo 2006, Segond Channel, N Aoré Island, Stn NB12, 15° 33.1'S, 167° 09.6'E, 20 m, 19Sep: 12.0 mm.

L. (Leiosolenus) ? parapurpurea: New Caledonia, Lifou 2000, SB, Stn 1456, NE de la Baie, 20° 49.3' S 167° 10.4' E, au niveau de Cila, tombant, 25-30 m, 26Nov: 20.0-7.5-5.9 mm. SB, Stn 1464, devant Peng, dragages, 20° 54.5' S 165° 05.9' E, blocs d'algues calcaires, 35-50 m, 14Nov: 19.7-6.7-4.9 mm.

Diagnosis

Shell purple, length up to 20 mm, posterior incrustation smooth.

Description

Purple shell small and fragile, generally less oval and more elongated in its proportions and shorter in maximum attainable size than *L. purpurea*. Apart from general *Leiosolenus* features, adult *L. parapurpurea* usually develop a thin and smooth posterior incrustation, scarcely protruding beyond the shell in the form of narrow lips, occasionally armed with minute spike(s) (Kleemann, 2008: figs 2A-C, 2E, 2G, 3A).

Remarks

Associated with faviid host corals *Cyphastrea* and *Echinopora*. The geographic range of the species, described primarily from the northern Red Sea and records from the Maldives and New Caledonia, appears to be widened by a sample from Vanuatu. Unfortunately, most Lithophaginae in the MNHN do not include samples or notes of the inhabited substrate, which are sometimes host corals for certain bivalve species.

Lithophaga (Leiosolenus) pulchra Lamy, 1919 (Fig. 14A-C)

Lithophaga pulchra Jousseaume (MS) - Lamy, 1919: pp. 345, 346.

Lithophaga (Diberus) pulchra Lamy - Lamy, 1937: p. 130.

Leiosolenus pulchra Lamy - Oliver, 1992: pp. 47, 54, 228, text-fig. 25, pl. 7, fig. 5a, b.

Leiosolenus (Diberus) pulcher (Jousseaume in Lamy) - Huber, 2010: p. 120, right figure in 3rd row.

Lithophaga (Leiosolenus) pulchra Lamy - Kleemann, 2010: p. 502, pl. 942, fig. 5 (non 7 = *L. nasuta*).

Types

Syntypes, MNHN, 46.0-16.1-12.3 mm, 42.5-16.3-13.0 mm, 38.9-14.5-11.9 mm. Type locality, Djibouti, Red Sea.

Material examined

Philippines, Panglao 2004, PI, Stn B4, 9° 33.2'N, 123° 48.3' E, BBC Point, reef slope with overhangs, 24 m, 01Jun: 16.4-6.9-5.3 mm (Fig. 14A-C). BAI, Stn B6, 9° 31.1' N, 123° 41.3' E, Black Forest, coral patches, 12-14 m, 04Jun: 24.2-9.3-7.3 mm, dead: 19.9-6.9-5.6 mm (+ predation hole). PI, Stn B36, 9° 35.9' N, 123° 44.5' E, North of Doljo, reef wall, 24 m, 01Jun: 18.7 mm.

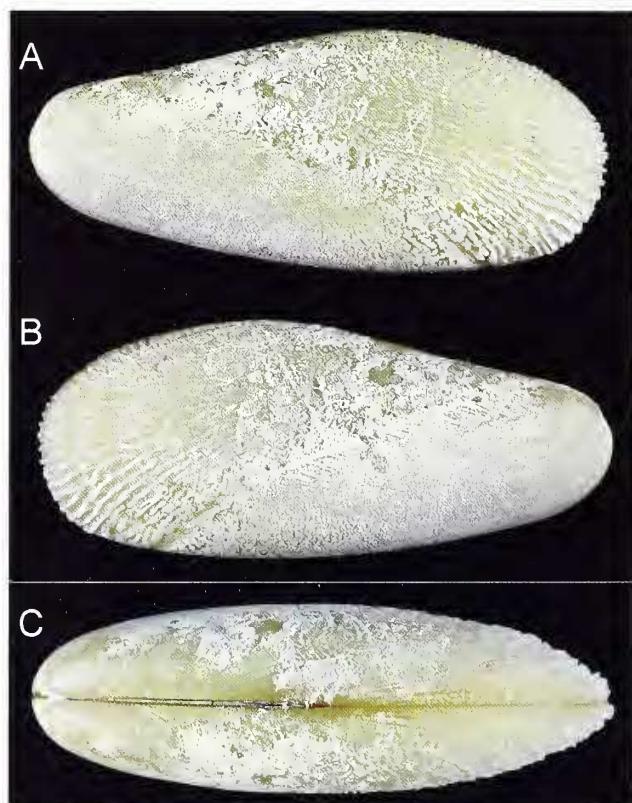


Fig. 14. *Lithophaga (Leiosolenus) pulchra* Lamy, 1919, 16.4-6.9-5.3 mm, **A**, vista laterale sinistra, **B**, vista laterale destra, e **C**, vista dorsale, 24 m, scarpata di scogliera con strapiombi, BBC Point, Panglao Island, Filippine, 9° 33.2'N, 123° 48.3' E, Stazione B4, 01 Giugno 2004. Foto P. Maestrati, MNHN.

Fig. 14. *Lithophaga (Leiosolenus) pulchra* Lamy, 1919, 16.4-6.9-5.3 mm, **A**, vista laterale sinistra, **B**, vista laterale destra, e **C**, vista dorsale, 24 m, scarpata di scogliera con strapiombi, BBC Point, Panglao Island, Filippine, 9° 33.2'N, 123° 48.3' E, Stazione B4, 01 Giugno 2004. Foto P. Maestrati, MNHN.

Diagnosis

Shorter posterior much more expanded than longer anterior, incrustation thickening, strongly reticulate, minimally projecting.

Description

Shell less than 50 mm long. Anterior hemispherical and distinctly narrower than the broadly rounded and somewhat wedge-shaped posterior end, ornamented by interlocking teeth-like projections of ridges (Kleemann 1980a: fig. 15) of the reticulate dorso-lateral incrustation, thickening posteriorly (Oliver 1992: text-fig. 25, pl. 7). Periostracum yellowish, antero-laterally covered by fine-grained calcareous deposits as in most *Leiosolenus* species. Dorsal line in front of the elevated, but inconspicuous angle about twice as long as behind, running somewhat steeper past the ligament.

Remarks

This rarely reported species, boring in dead coral, was previously known only from the Red Sea, with Dahab, Sinai peninsula, as the northern-most locality (own data).

Lithophaga (Leiosolenus) purpurea Kleemann, 1980

Lithophaga lima (part, non Lamy, 1919) - Gohar & Soliman, 1963a: pp. 65, 67, 91-95, text-figs 14-18, except specimens from *Cyphastrea*.

Lithophaga lima (non Lamy, 1919) - Gohar & Soliman, 1963b: pp. 214, 216.

Lithophaga lima (part, non Lamy, 1919) - Soliman, 1969: pp. 888, 890, text-figs 1C, 2D.

Lithophaga purpurea (part) Kleemann, 1980: pp. 21-25, figs 8-9; only from *Montipora*.

Lithophaga purpurea (part) Kleemann, 1990c: pp. 78, 86, 91, only from *Montipora* (non fig. 5 = *Astreopora*).

Lithophaga purpurea (part) Kleemann - Brickner et al., 1993: pp. 139-145, only from *Montipora*.

Lithophaga (Leiosolenus) purpurea Kleemann - Kleemann, 2008: pp. 32, 36-37, 43, fig. 1 top and middle.

Types

Holotype: NHMUK 197811, 19.7-7.6-6.2 mm (Kleemann 1980: figs 9-10). Paratype: NHMUK 197812, 15.4-6.6-5.3 mm (Kleemann 1980: figs 9-10). Host coral, *Montastrea cf. stilosa* (Ehrenberg, 1834). Type Locality, fore reef slope, 11-13 m, near Aqaba ($29^{\circ} 26' N$, $34^{\circ} 58' E$), Jordan, Red Sea.

Material examined

New Caledonia, Lifou 2000, SB, Stn 1451, $20^{\circ} 47.3' S$ $167^{\circ} 06.8' E$, Ouest de la Pointe d'Easo, 2^{ème} patate corallienne, 10-21 m, 19Nov: 22.9-8.8-?, >15.5 mm. SB, Stn 1459, $20^{\circ} 47.0' S$, $167^{\circ} 03.0' E$, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 11.6-4.3-3.4 mm. SB, Stn 1464, $20^{\circ} 54.5' S$ $167^{\circ} 05.9' E$, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 14.2-5.6-4.2 mm.

Diagnosis

Shell purple, up to 35 mm, posterior higher than anterior end, posterior incrustation in a fine, file-like pattern, not protruding.

Description

Shell small, thin, fragile, smooth, purple, periostracum covered by whitish deposits, paste-like and not adhesive on the anterodorsal area, thin, smooth and adhering to the shell on the anteroventral part of the shell. A fine and often inconspicuous line runs from the umbos to the posterior ventral margin, behind this line, the incrustation becomes more dense, with wavy semicircular, very delicate, toothed ridges becoming coarser towards the edges. They are arranged as in fingerprints, only discontinuous and with more interconnections, thus resembling the surface of a fine file, similar as in *L. lima*. Outline of shell more oval and less elongated than in other species, may resemble very small *L. obesa* from dead coral because the posterior end is somewhat inflated, both ends evenly rounded. Umbos subterminal, inconspicuous. Ventral margin slightly convex. Dorsal margin elevated, but without a distinct angle where the straight hinge line stops (Kleemann, 1980a: p. 21).

Remarks

Animals associated with acroporid *Montipora* species. For a detailed review of the species and separation from *parapurplea* and *dahabeensis* see Kleemann (2008).

Lithophaga (Leiosolenus) simplex Iredale, 1939

Lithophaga cumingiana (part) Otter, 1937: p. 346 (from live *Favia* only).

Lithophaga calcifer (part) Iredale, 1939: p. 420 (from live *Favia* only).

Lithophaga simplex (part) Iredale, 1939: p. 421 (from live *Symphyllia* only), pl. 6, fig. 25. Kleemann, 1980a: pp. 38, 44, figs 7 (holotype), 37. Morton & Scott, 1980: pp. 179 ff, pl. 1, fig. g. Mokady et al., 1992: pp. 243-251. Mokady et al. 1993: pp. 245, 247, 248, 250, 251; Kleemann, 1995: tab. 1. Kleemann & Hoeksema, 2002: p. 15.

L. (Leiosolenus) simplex Iredale - Kleemann, 1977: pp. (151), 152-153, (154), figs. 1b, 7a-d, 8. Kleemann, 2010: p. 502, pl. 942, fig. 1.

Leiosolenus (Leiosolenus) simplex (Iredale) - Huber, 2010: p. 120, left figure in 1st row.

Types

Holotype, AM C60403, 27.4-9.8-(4.1 x2) mm (Kleemann, 1980a: fig. 7). Type locality, Low Island, Queensland, Australia. Host corals, *Porites* (in error), *Symphyllia* (and others, Kleemann, 1980a).

Material examined

New Caledonia, Lifou 2000, GB, Stn 1436, $20^{\circ} 55.5' S$ $167^{\circ} 04.2' E$, patate corallienne sur tombant, 10-20 m,

10Nov: rv 14.7-6.3-(2.5 x2), lv 13.9-5.6-(2.3 x2), 9.2-4.0-3.4 mm. SB, Stn 1456, 20° 49.3' S 167° 10.4' E, NE de la baie, au niveau de Cila, tombant, 25-30 m, 26Nov: 10.1-5.0-4.2 mm. SB, Stn 1459, 20°47.0' S, 167°03.0' E, face à la plage de Ngoni, dragages, 55-60 m, 5/13Nov: 13.4-4.8-4.8 mm. As before: 16.9-6.3-5.5, 16.5-5.4-4.3, 15.3-5.8-4.7, 15.1-6.0-4.8, 15.1-5.5-4.7, 14.7-5.9-5.2, 14.5-5.5-4.7, 14.3-5.7-4.7, 14.1-5.6-4.5, 13.6-5.2-4.3, 12.9-5.4-5.1, 12.1-5.6-4.8, 12.1-4.9-3.9, 12.0-5.0-3.9, 11.9-5.3-4.5, 11.0-5.0-?, 11.0-4.6-3.8, 10.9-4.8-3.9, 10.6-4.4-3.5, 9.8-4.2-3.6, 9.3-3.9-3.3, 8.9-3.5-3.0, 8.1-3.8-3.2, 7.8-3.3-2.9, 7.5-3.4-2.6, 7.5-3.0-2.6, 7.3-2.9-2.5, ~10, ~10, ~10, ~9, 5.3, 4.6, 3.8 mm; dead: rv 8.7, lv 7.3, lv 7.0, rv 6.8 mm. SB, Stn 1460, 20° 52.4' S, 167° 08.0' E, Est de la baie, devant l'îlot Huca Hutighé, dragages, 40-60 m, 06Nov: 10.6-4.3-4.6 mm. As before: 13.5, lv 12.6, 11.8-4.7-4.1, 11.0-4.6-3.9, 11.0, 10.1-3.9-3.3, 10.1, 9.7-3.7-3.0, 9.6-3.9-3.2, rv 8.7-3.8-(1.3 x2), 7.3-3.0-2.5 mm. SB, Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 13.7-5.4-4.9 mm. SB, Stn 1465, 20° 47.7' S 167° 07.0' E, de part et d'autre de la Pointe d'Easo, dragages, blocs et coraux, 35-44 m, 16Nov: 11.6-4.5-3.6, 7.7-3.3-3.0, lv 9.2-3.9-(1.6 x2) mm. As before: 13.4-5.3-4.7, 11.4-4.5-3.6, 10.5-4.4-3.8, 10.3-4.3-3.9, 9.9-4.6-3.9, 9.3-4-4.1-3.5, 8.8-3.8-3.3, 8.2-3.9-3.6, 6.8-3.2-2.7 mm. Philippines, Panglao 2004, PI, Stn B12, 9° 36.6'N, 123° 43.2'E, Doljo Point, reef slope, 24-27 m, 14Jun: 6.4-2.9-2.7 mm (Kleemann 2010, pl. 942, fig. 1). Bohol Island, Stn R43, 9° 41.3'N, 123° 49.5'E, Cortes Tacot, isolated coral plateau, 3-41 m, 13Jun: ~16 mm, broken.

Lithophaga ? simplex. New Caledonia, Expédition Montrouzier, TS, Stn 1256, 20° 45.0' S, 165° 09.8' E, Lagon devant Vieux Touho, corail vivant, vase, 15-20 m: 10.1-4.6-4.0 mm. Lifou 2000, SB, Stn 1464, 20° 54.5' S 167° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: lv 11.8-5.4-? mm. Philippines, Panglao 2004, Stn B39, 9° 32.8'N, 123° 42.1'E, Pontod Lagoon 1, reef wall with small caves, 17-25 m, 02Jul04: 6.0 mm.

Diagnosis

Shell without real incrustation, only patchy chalky layers on yellow periostracum.

Description

Shell up to 30 mm long, thin, smooth and fragile, periostracum yellow, lacking real (posterior) incrustation, but sparsely covered by thin, fine grained calcareous patches.

Remarks

Associations with corals were investigated at the Great Barrier Reef of Australia (Otter, 1937; Iredale, 1939; Wilson, 1979, 1985; Kleemann, 1980a, 1995), and in the northern Red Sea (Gohar & Soliman, 1963a; Soliman, 1969; Kleemann, 1980a, 1995; Mokady et al., 1993), but were not always the same. Common in acroporid *Astreopora*,

faviid *Favia* and *Goniastrea*, rare in mussid *Lobophyllia* and *Sympyphilia* (Kleemann, 1995: tab. 1).

Lithophaga (Leiosolenus) subattenuata n. sp.
(Figs 15A-C, 16A-C)

Types

Holotype MNHN 25601, 13.0-4.4-4.1 mm (Fig. 15A-C), 2 paratypes MNHN 25602, paratype 1: 11.1-3.9-3.5 mm (Fig. 16A-C), paratype 2: 9.8-3.9-3.7 mm. Type locality, Philippines, Panglao 2004, Balicasag Island, Stn B6, 9° 31.1' N, 123° 41.3' E, Black Forest, coral patches, 12-14 m.

Material examined

New Caledonia, Expédition Montrouzier, TS, Stn 1271, 20° 52.7' S 165° 19.5' E, Haut-Fond de la Tié, tombants, sable sur dalle, 5-25 m: 16.0-5.1-4.8 mm. Lifou 2000, SB, Stn 1429, 20° 47.5' S 167° 07.1' E, Ouest/Sud-Ouest de la Pointe d'Easo patate corallienne, passées sédimentaires, 8-18 m, 3/5/23-24Nov: 9.7-4.2-3.7 mm. SB, Stn 1459, 20°47.0' S, 167°03.0' E, face à la plaque de Ngoni, dragages, 55-60 m, 5/13Nov: 12.2-4.4-4.1, 11.5-4.3-3.7, 9.8-4.0-3.7 mm. SB, Stn 1464, 20° 54.5' S 165° 05.9' E, devant Peng, dragages, blocs d'algues calcaires, 35-50 m, 14Nov: 18.4-6.6-7.0, 14.5-5.8-5.5, 13.4-5.0-?, 11.4-4.6-4.5 mm. Philippines, Panglao 2004, PI, Stn B4, 9° 33.2'N, 123° 41.3' E, Black Forest, coral patches, 12-14 m.

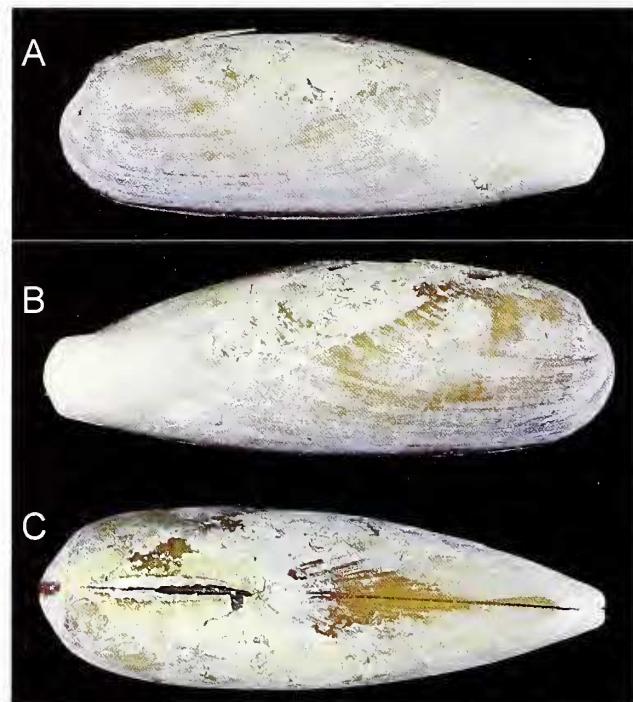


Fig. 15. *Lithophaga (Leiosolenus) subattenuata* n. sp., holotype, 13.0-4.4-4.1 mm, A, left lateral, B, right lateral, and C, dorsal view, from 12-14 m, coral patches, Black Forest, Balicasag Island, Philippines, 9° 31.1' N, 123° 41.3' E, Stn B6, 04Jun04. Images by P. Maestrati, MNHN.

Fig. 15. *Lithophaga (Leiosolenus) subattenuata* n. sp., olotipo, 13.0-4.4-4.1 mm, A, vista laterale sinistra, B, vista laterale destra, e C, vista dorsale, 12-14 m, piccole aree a coralli, Black Forest, Balicasag Island, Filippine, 9° 31.1' N, 123° 41.3' E, Stazione B6, 04 Giugno 2004. Foto P. Maestrati, MNHN.

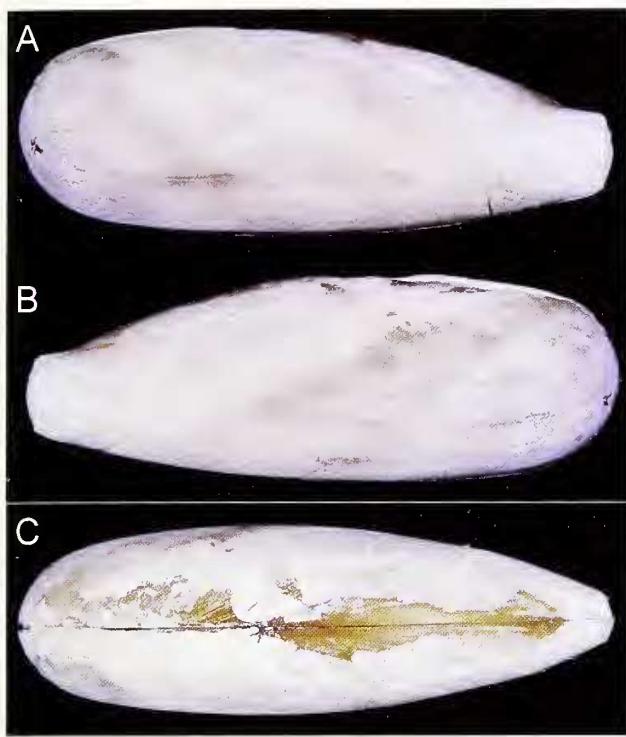


Fig. 16. *Lithophaga (Leiosolenus) subattenuata* n. sp., paratypo 1, 11.1-3.9-3.5 mm, **A.** left lateral, **B.** right lateral, and **C.** dorsal view, from 12-14 m, coral patches, Black Forest, Balicasag Island, Philippines, 9° 31.1' N, 123° 41.3' E, Stn B6, 04Jun04. Images by P. Maestrati, MNHN.

Fig. 16. *Lithophaga (Leiosolenus) subattenuata* n. sp., paratypo 1, 11.1-3.9-3.5 mm, **A.** vista laterale sinistra, **B.** vista laterale destra, e **C.** vista dorsale, 12-14 m, piccole aree a coralli, Black Forest, Balicasag Island, Filippine, 9° 31,1' N, 123° 41,3' E, Stazione B6, 04 Giugno 2004. Foto P. Maestrati, MNHN.

123° 48.3' E, BBC Point, reef slope with overhangs, 24 m, 01Jun: 10.9-3.9-3.6, 6.4 mm. PI, Stn B5, 9° 35.2' N, 123° 50.4' E, Biking, reef slope with overhangs, 4 m, 02Jun: 9.3-3.3-3.1, 7.1 mm. BAI, Stn B6, 9° 31.1' N, 123° 41.3' E, Black Forest, coral patches, 12-14 m, 04Jun: 11.1-3.4-3.3, 10.6-4.2-4.0 (disarticulated), 9.0, 8.8 (disarticulated), 8.2, 7.7, 7.0, 6.8, 5.0, 4.2, 3.6 mm. As before: 11.1-4.1-3.7 mm, with dead, shelly, incrusted substrate. PI, Stn B7, 9° 35.9' N, 123° 51.8' E, Catarman, reef slope with caves, 4-30 m, 05Jun: 8.7, 6.8, 6.2 mm. Pamilacan Island, Stn B11, 9° 29.4' N, 123° 56.0' E, coral rubble, 2-4 m 11Jun: 10.3-3.8-3.5, 9.5-3.4-3.1 mm. PI, Stn B14, Sungcolan Bay, coral rubble, 9° 38.5' N, 123° 49.2' E, 2-4 m, 16Jun: >10, 10.2, 8.8, 7.6, 7.2, 6.3, 5.2, 4.1 mm. PI, Stn B17, 9° 37.5' N, 123° 46.9' E, Bingag, reef wall with small caves, 3-21 m, 19Jun: 9.9-3.6-3.3 mm. PI, Stn B18, 9° 38.5' N, 123° 49.7' E, Sungcolan Bay, blocks dispersed among seagrass, 3-5 m, 20Jun: 13.9-5.3-4.7, 8.5 mm. PI, Stn B39, 9° 32.8' N, 123° 42.1' E, Pontod Lagoon 1, reef wall with small caves, 17-25 m, 02Jul: 7.3 mm. BAI, Stn R16, 9° 31.1' N, 123° 41.3' E, Black Forest, 6-22 m, 04Jun: 9.3-3.8-3.5 mm. BAI, Stn B41, 17-19 m, floor of large cave, 9° 30.9' N, 123° 40.8 E, 04Jul: 8.7 mm, 6.5 mm, 4.4 mm. Vanuatu, Santo 2006, Stn DB29, 15° 38.9' S, 167° 05.1' E, W Malo Island, 15 m, 17Sep: 11.6-4.4-3.9 mm.

L. (Leiosolenus) ? subattenuata n. sp.: Philippines, Panglao 2004, PI, Stn B9, 9° 33.1' N, 123° 44.0' E, Napaling,

caves ib the reef wall, 8-10 m, 08Jun: 6.8 mm. PI, Stn B12, 9° 36.6' N, 123° 43.2' E, Doljo Point, reef slope, 24-27 m, 14Jun: 8.5 mm. PI, Stn B18, 9° 38.5' N, 123° 49.7' E, Sungcolan Bay, blocks dispersed among seagrass, 3-5 m, 20Jun: 13.3, 8.7 mm. BAI, Stn B41, 9° 30.9' N, 123° 40.8 E, floor of large cave, 17-19 m, 04Jul: 9.6-4.1-3.9 mm, 9.1-3.0-2.4. PI, Stn S23, 9° 35.7' N, 123° 44.7' E, Looc, sand and seagrass, 2 m, 22Jun: 10, 6 mm.

Etymology

The name refers to the large growing *attenuata* (Deshayes, 1836) from the East Pacific.

Diagnosis

Small “*Labis*” Dall, 1916, posterior incrustation resembling *attenuata* (Deshayes, 1836), ending in a protruding stump.

Description

Shell thin, fragile, with protruding incrustation probably up to 20 mm in length, umbos subterminal and inconspicuous, anterior end almost hemispherical, middle cylindrical, posterior half wedge-shaped and attenuated towards the end, dorsal line decreasing faster than in *L. attenuata*, but not as steep as in the even shorter, truncated shells of *L. mucronata*. Antero-dorsal line and ventral line nearly parallel, dorsal angle less obvious in *subattenuata* n. sp. than in *mucronata*. Light brown periostracum, mainly covered by generally thin, calcareous deposits, except at the posterior end, where a solid, smooth, conical, projecting stump with a convex surface is formed to seal the boring entrance when disturbed. Dead-coral borer.

Remarks

A valid species in the view of Kleemann, although similarities to another small species, *L. mucronata*, also from dead substrates, make it sometimes difficult to determine individuals. The posterior protruding incrustation, of both valves combined, usually forms a narrow, slightly convex stump. In contrast, in *L. hanleyana* the termination of the incrustation would generally be distinctly wider, truncated and forming a pair of concave lips in posterior view (Kleemann, 1984: fig. 8). In *L. mucronata*, the posterior shell prolongation usually ends in an obliquely cut, and concave-ending stump, with a more dorsally pointed extension (Figs 8A, B, 9).

Discussion and conclusions

The taxonomic distinction of the species of *Lithophaga* s.s. is relatively simple because there are only a few worldwide. The black-coloured *teres* (including synonyms sensu Kleemann, 1984; several authors regard the

Atlantic *nigra* to be distinct, e.g. Huber, 2010). Local differences in size range as well as individual shell outlines or colour shades do occur. Nevertheless, these variations should not be treated as a pretext for establishing new species, as was common in the past, sometimes supported by commercial interest. The brown *lithophaga* may be endemic to the Mediterranean. The type material of *lithophaga*, stored at the Royal Society of London, includes black specimens (pers. data, unpubl.). The variation in the shape of *lithophaga*, as demonstrated in Kleemann (1974: fig. 2a, d), should not lead to a splitting into subspecies or even species. Oliver (1995) considers *robusta* Jousseaume (MS) Lamy, 1919, type locality Djibouti, respectively Aden, as distinct, while Kleemann (1983: p. 21) suggested '? *lithophaga* var'. The yellow *straminea* is regarded as a valid species (see above). The circumtropical *corrugata*, including synonyms (see above and Kleemann, 1980b), is easily recognized by its criss-cross striae on the posterior half of the valves.

The taxonomic distinction of species in the subgenus *Leiosolenus* is more complicated due to their larger number and smaller size range. Determination is mainly based on the different patterns of the posterior incrustation of the valves, considered to be species specific (Kleemann 1977, 1980a, 1982, 1990ab, 2008, 2009, 2010; Kleemann & Hoeksema, 2002). The shape of the valves alone may also be quite distinctive as in large-growing *obesa* (Fig. 11) and middle-sized *pulchra* (Fig. 14): both have an inflated posterior half but very different incrustations. Further very distinct and easily recognizable incrustations are developed in adult *canalifera* (Fig. 1) and *divaricalx* (Fig. 2).

The natural variation in both shape and incrustation pattern in members of the different species, and the resulting effects in their geographical distribution, must be carefully considered when determining individual specimens. This may be demonstrated for example in *malaccana* (Figs 6, 7; Kleemann, 1984: figs 10-13), from the same site or geographically dispersed localities. The latter species, in the present material, shows also a similarity to *paraplumula* n. sp. (Figs 15, 16) in the rough incrustation, but its outline lacks an obvious dorsal angle. Some rather small species, such as the mentioned *laevigata* (Fig. 5), *parapurpurea* and *purpurea*, are associated with certain host corals (Kleemann, 1980a, 2008). This should be recorded during collecting and would facilitate bivalve determination, particularly if coral fragments are taken together with the borers.

Similar species are, of course, most difficult to distinguish, even for an experienced observer (Kleemann, 2008). Quite often, the distinction between similar species remains uncertain. This is particularly true when the respective typical incrustation patterns are not well enough developed, as in many young specimens. Some syntypes of *Lithophaga* species in the Natural History Museum London, belonged to more than one species. From the three in *L. hanleyana*, each belonged to a separate species (Kleemann, 1984). Consequently, the older literature is full of confusions, which still leads to mistakes in modern determinations.

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Appendix

Key to the species of *Lithophaga* s.s. and its subgenus *Leiosolenus* from recent collections in the MNHN
 (Described features may be present only in adult specimens.)

Lithophaga Röding, 1798: p. 156.

- 1a Specimen with vertical striae antero-latero-ventrally (no self-deposited calcareous incrustation on the shell surface), member of *Lithophaga* s.s. 2
- 1b Specimen without vertical striae antero-latero-ventrally and free of self-deposited calcareous incrustation on the shell surface (but capable of lining the borehole in its host coral); endosymbiont in *Stylocoeniella*
L. (Leiosolenus) dahabensis Kleemann, 2008
- 1c Specimen lacking vertical striae, shell surface covered to some extent by a self-deposited calcareous incrustation, member of subgenus *Leiosolenus* 3
- 2a Specimen with dark brown to black periostracum *L. (Lithophaga) teres* (Philippi, 1846)
- 2b Specimen with yellowish periostracum *L. (Lithophaga) straminea* (Reeve, 1857)
- 2c Specimen with posterior additional criss-cross striation *L. (Lithophaga) corrugata* (Philippi, 1846)
- 3a Specimen partly covered by a thin calcareous veneer, without obvious posterior incrustation, periostracum yellowish; endosymbiont of certain host corals (Kleemann, 1995: tab. 1) *L. (Leiosolenus) simplex* Iredale, 1939
- 3b Specimen antero-ventrally partly covered by a thin calcareous veneer, posterior incrustation weak, fine-grained, not protruding the slightly attenuated shell rim, periostracum light brown; endosymbiont of certain, particularly pocilloporid host corals (Kleemann, 1995: tab. 1) *L. (Leiosolenus) lessepsiana* (Vaillant, 1865)
- 3c Specimen's incrustation fine-grained, thin antero-ventrally, slightly thickening dorso-posteriorly, covering the darker-pigmented, purplish sector running from the umbo posterio-ventrally, hardly protruding over the shell edge
L. (Leiosolenus) nasuta (Philippi, 1846)
- 3d Specimen with a distinct posterior incrustation, not protruding or not protruding beyond the shell rim, thus leaving the shell outline almost as it is 4
- 3e Specimen's posterior incrustation protruding considerably beyond the shell rim, distorting the original shell outline 5
- 4a Posterior incrustation may appear to be smooth, but consists of fine lines or low divaricating ridges, with softer deposits between, ending in interconnecting teeth; endosymbiont of many host corals of various families (Kleemann 1977, 1980a, 1995, 2008, Kleemann & Hoeksema, 2002) *L. (Leiosolenus) laevigata* (Quoy & Gaimard, 1835)
- 4b Posterior incrustation consisting of grains, becoming coarser from the umbo to the end (similar to *obesa*), periostracum purple; endosymbiont in *Montipora* host corals (Kleemann 2008) *L. (Leiosolenus) purpurea* Kleemann, 1980
- 4c Posterior incrustation consisting of grains, becoming coarser from the umbo to the end, periostracum yellowish to light brown, posterior inflated, higher than anterior end *L. (Leiosolenus) obesa* (Philippi, 1847)
- 4c Posterior incrustation consisting of distinct straight ridges, divaricating and coarser towards the end, periostracum yellowish, posterior end inflated, higher than anterior *L. (Leiosolenus) pulchra* Lamy, 1919
- 4d Posterior incrustation smooth and solid, ending in a thin lip-like edge (occasionally with spikes), periostracum purple, endosymbiont of certain *Cyphastrea* and *Echiopora* host corals *L. (Leiosolenus) parapurpurea* Kleemann, 2008
- 5a Posterior incrustation generally smooth, solid, protruding broadly truncated beyond the shell rim
L. (Leiosolenus) hanleyana (Reeve, 1857)
- 5b Posterior incrustation rather smooth and solid, protruding the truncated shell rim with a prominent, median, spur-like elongation *L. (Leiosolenus) lithura* Pilsbry, 1905
- 5c Posterior incrustation smooth and solid, protruding attenuated past the shell rim, ending in a narrow stump, not hollow inside *L. (Leiosolenus) subattenuata* n. sp.
- 5d Posterior incrustation usually smooth and thick for such a small shell, elongating the truncated shell rim in a narrow, obliquely cut, concave stump, with a short spur *L. (Leiosolenus) mucronata* (Philippi, 1846)
- 5e Posterior incrustation composed of posteriorly thickening, longitudinal, projecting ridges, separated by channels, partly filled with softer deposits *L. (Leiosolenus) caualifera* (Hanley, 1843)

5f Posterior incrustation composed of posteriorly thickening deposits, usually in a reticulated pattern of diagonally crossing, narrow ridges. Voids may be (partly) filled with softer deposits, giving the otherwise pitted surface a smooth appearance. In variation, undulating ridges may be oriented more vertically, resembling ripple marks

L. (Leiosolenus) malaccana (Reeve, 1857)

5g Posterior incrustation composed of posteriorly thickening deposits, usually in a more plume-like, less reticulate pattern of elevated ridges above the shell, voids may be (partly) filled with softer deposits, while beyond the shell rim the incrustation forms outside a bishop-hat structure, that is rather solid on the outside, hollow inside

L. (Leiosolenus) paraphlumula n. sp.

5h Posterior incrustation composed of posteriorly thickening, coarse ridges in a plume-like pattern. Dorsal angle prominent, posterior short, attenuated

L. (Leiosolenus) divaricalx Iredale, 1939